

SECTION 600 INCIDENTAL CONSTRUCTION



Section 601 - Mobilization

DESCRIPTION

601.01
Work

This work shall consist of preparatory work and operations necessary for the movement of personnel, equipment, supplies, and incidentals to the project site, and for all other work and operations that must be performed or that cause costs to be incurred prior to beginning work on the various items on the project site.

MEASUREMENT

601.02
Method

The method of measurement, as described in Section 106, will be DESIGNATED in the SCHEDULE OF ITEMS.

PAYMENT

601.03
Basis

Mobilization will be paid for at the contract unit price for the item as shown in the SCHEDULE OF ITEMS.

Progress payments will be made as follows:

(a) When 5 percent or more of the original contract amount is earned from other pay items, 50 percent of the amount for mobilization, or 5 percent of the original contract amount, whichever is less, will be paid.

(b) When 10 percent or more of the original contract amount is earned from other pay items, 100 percent of the amount for mobilization, or 10 percent of the original contract amount, whichever is less, will be paid.

(c) Upon completion of all work on the project, any unpaid amount for mobilization will be paid.

The total of all payments, including bonding, shall not exceed the original contract amount for this item.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
601(01) Mobilization	L.S.

Section 602 - Minor Concrete Structures

DESCRIPTION

602.01 This work shall consist of constructing reinforced or
Work unreinforced minor concrete structures.

MATERIALS

602.02 Materials shall meet the requirements of the following Subsections:
Requirements

Mortar	701.03
Portland Cement	701.01
Aggregate	703.01(c)
Reinforcing Steel	709.01
Curing Materials	711.01
Air-Entraining Admixtures	711.02
Water	712.01
Fly Ash	712.14

602.03 The concrete composition method shall be as shown in the SCHEDULE
Concrete Composition OF ITEMS.

Method A. A mix design showing the proposed weights of aggregate, water, and cement per cubic yard of concrete shall be furnished to the Engineer. Cement, aggregate, and water shall be proportioned to obtain concrete with good workability. Slump shall not be more than 4 inches as determined by AASHTO T 119. Air-entrainment shall be 5 percent plus or minus 1 percent as determined by AASHTO T 152 or T 196.

The concrete shall develop a 28-day minimum compressive strength of 3,000 psi unless otherwise SHOWN ON THE DRAWINGS. Concrete for specimens shall be furnished by the contractor at no cost to the Government. Strength will be determined by test cylinders made and cured in accordance with AASHTO T 23 and tested in accordance with AASHTO T 22.

Failure of any test cylinder for any structural element tested will be considered evidence of noncompliance with the strength requirement of this specification.

Method B. The contractor shall submit for approval the following information:

- (a) The type, grading, and sources of aggregate.
- (b) Type and source of cement, blended cement, or fly ash.
- (c) Proposed scale weights of each aggregate in pounds per cubic yard of concrete.
- (d) Proposed quantity of water in pounds per cubic yard of concrete.
- (e) Proposed quantity of cement in pounds per cubic yard of concrete.
- (f) Admixtures.
- (g) Air content.
- (h) Slump.
- (i) 28-day compressive strength.

The concrete shall contain not less than 5.5 sacks of cement per cubic yard. Slump shall not be more than 4 inches as determined by AASHTO T 119.

When a commercial supplier is used, the contractor shall furnish a certification with each truckload of concrete certifying that the material and mix proportions used are in conformance with the approved mixture.

Method C. The concrete shall be made using a dry, preproportioned, blended, and bagged mix meeting the requirements of ASTM C 387 and mixed at the jobsite in accordance with the manufacturer's recommendations.

Fly Ash or Pozzolan Modified Concrete - Fly ash, at the contractor's option, may be substituted for cement at the rate of 1.2 pounds of fly ash for 1.0 pounds of Portland cement. After substitution, design aggregate volumes shall be reduced by an amount equal to the net increase in volume of the combined cement and fly ash. Not less than 10 percent nor more than 20 percent of the weight of Portland cement required may be replaced with fly ash at the above rate. For purposes of controlling the maximum water/cement ratio of 0.49, the water/cement ratio for fly ash modified concrete shall be the ratio of the weight of water to the combined weights of Portland cement and 60 percent of the weight of the fly ash.

The standard 28-day curing period for compressive strength tests shall be extended for fly ash modified concrete by 1 day (rounded to the nearest whole day) for each 1.5 percent of Portland cement replaced with fly ash at the selected rate. (Example: If the maximum of 20 percent cement is replaced, the curing period for cylinders would be 41 days.)

CONSTRUCTION

602.04 Forms

Forms shall be designed and constructed so they can be removed without damaging the concrete. They shall be free of bulge and warp, and constructed so the finished concrete shall be of the form and dimensions SHOWN ON THE DRAWINGS and true to line and grade. Concrete may be placed without forms where SHOWN ON THE DRAWINGS.

Forms for concrete containing a retarding admixture, fly ash, or other pozzolan replacement for cement shall be designed to contain the lateral pressures exerted by the full anticipated height of fluidized concrete, unless documented information in regard to initial set is provided by the manufacturer.

602.05 Placing Concrete

All reinforcing steel shall be placed in position SHOWN ON THE DRAWINGS and securely held in place by approved supports during placing of concrete. Concrete shall not be placed until the grading, forms, and steel reinforcements have been inspected and approved by the Engineer. The contractor shall give the Engineer 24 hours notice prior to placement of any concrete.

Method A & B concrete shall be discharged into the forms within 1-1/2 hours after the introduction of the cement to the aggregate. Method C concrete shall be discharged into the forms within 1-1/2 hours after the introduction of water to the mixture. Retempering concrete shall not be permitted. The cement shall be added to the mixer at the jobsite whenever this condition cannot be met, or when required in the SPECIAL PROJECT SPECIFICATIONS. Concrete shall not be mixed or placed when the daily minimum atmospheric temperature is, or is expected to be, less than 40 °F unless adequate provisions are made to protect the concrete.

Concrete shall be placed to avoid segregation. High-frequency internal vibrators shall be used for consolidating concrete in the forms. Vibrators shall be operated to produce concrete free of voids, but shall not be held so long in one place as to result in segregation or formation of laitance on the surface.

Method C concrete shall be placed in forms and may be rodded instead of internally vibrated as necessary to remove voids.

The use of aluminum pipe, conduit, or troughs for transporting concrete will not be permitted. When concrete is pumped, sampling shall be from the discharge stream at the point of placement.

602.06
Finishing

(a) Formed Surfaces. Unless otherwise SHOWN ON THE DRAWINGS, all fins and irregular projections exceeding 1/4 inch shall be removed from the exposed surfaces. Holes produced by removal of form ties shall be filled with dry-pack mortar or other approved patching compounds.

(b) Unformed Surfaces. Unformed surfaces shall be struck off with a straight-edge and finished to a smooth uniform texture by floating and traveling. Final finish of the surface will be as SHOWN ON THE DRAWINGS.

602.07
Curing Concrete

Beginning immediately after finishing, all concrete shall be cured a minimum of 7 days or, if high early strength cement is used, a minimum of 3 days. For fly ash modified concrete placed in structures, the required moisture controlled curing period shall be:

<u>Percentage of Cement Replaced by Weight</u>	<u>Required Curing Period</u>
10%	9 days
11-15%	10 days
16-20%	11 days

For cold weather concreting, controlled temperature shall be maintained for the required curing period. The above requirement for an extended curing period may be waived if a compressive strength of 65 percent of the specified 28-day design strength is achieved in 6 days.

Curing shall be accomplished to maintain a minimum concrete temperature of 40 °F and to maintain concrete in a continuously moist condition. Concrete shall be maintained in a moist condition by supplying additional moisture or by preventing moisture loss.

Acceptable methods of supplying additional moisture are by ponding or sprinkling, and covering with burlap cloth maintained in a saturated condition. Surfaces SHOWN ON THE DRAWINGS may be covered with saturated sand or 6 inches of saturated hay or straw to retain moisture.

Acceptable methods of preventing moisture loss are by applying liquid membrane-forming compounds, or waterproof paper or polyethylene sheet materials. Liquid membrane-forming compounds shall be applied by spraying at the coverage rates and patterns recommended by the manufacturer. Sheet materials shall have overlapped sealed joints and form a complete waterproof cover over the entire concrete surface.

602.08
Backfilling

Backfilling shall be in accordance with Subsection 206A.05.

602.09
(Reserved)

MEASUREMENT

602.10
Method

The method of measurement, as described in Section 106, will be DESIGNATED in the SCHEDULE OF ITEMS.

PAYMENT

602.11
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
602(01) Concrete Method A	C.Y.
602(02) Concrete Method B	C.Y.
602(03) Concrete Method C	L.S.

Section 603 - Metal Pipe

DESCRIPTION

603.01
Work This work shall consist of furnishing and installing, or installing only, metal pipe and pipe appurtenances, including all bedding and backfilling required to complete the work. The term metal refers to aluminum, and steel.

MATERIALS

603.02
Requirements Materials shall meet the requirements of the following Subsections:

Flexible Plastic Gaskets	705.09
Corrugated Steel Pipe and Pipe Arches.	707.01
Bituminous-Coated Corrugated Steel Pipe and Pipe Arches	707.02
Polymeric-Precoated Steel Pipe, Pipe Arches, and Underdrains	707.03
Corrugated Aluminum Alloy Culvert Pipe	707.06
Bituminous-Coated Corrugated Aluminum Alloy Culvert Pipe	707.08
Rubber Gaskets	705.03
Aluminum-Coated Type 2 Corrugated Steel Pipe and Pipe Arches	707.13
Aluminum-Zinc Coated Corrugated Steel Pipe and Pipe Arches	707.14
Bituminous-Coated Polymeric-Precoated Steel Pipe, Pipe Arches and Underdrains	707.15

Bedding material shall meet the requirements of Subsection 603.04.

Backfill materials shall meet the requirements of Subsection 603.08.

Damaged spelter coating caused by welding, field cutting, or mishandling shall be cleaned and painted as specified in AASHTO M 36.

End sections shall be constructed of a material meeting the requirements of AASHTO M 218 or AASHTO M 36.

Bituminous-coated end sections shall be coated to meet the requirements of AASHTO M 243 or AASHTO M 190.

The materials used in each pipe installation shall be compatible with each other to prevent electrolysis or physical failure.

Either annular or helical pipe corrugations will be acceptable; and helical corrugated pipe containing annular rerolled ends may be used in conjunction with annular pipe of like or compatible materials.

A fabricators Certification shall be furnished certifying that the sheet and pipe fabrication are in accordance with AASHTO M 36, M 196, and M 245 as applicable. The Certification shall be submitted prior to installation of the pipe.

The lengths and locations of individual pipe SHOWN ON THE DRAWINGS are approximate. Pipe shall not be ordered until culvert locations are DESIGNATED ON THE GROUND and a written list of the correct lengths is issued by the Engineer.

CONSTRUCTION

603.03
Excavation Excavation shall be in accordance with the requirements of Section 206A.

Pipe that is installed in or that will affect streams SHOWN ON THE DRAWINGS as important fisheries shall be installed only during those periods SHOWN ON THE DRAWINGS.

603.04
Bedding

Bedding shall consist of bedding the pipe to a depth of not less than 10 percent of its total height. The foundation surface, after excavation in accordance with Subsection 206A.03 (b), shall be compacted in accordance with Subsection 603.08 and shaped to fit the pipe.

The bedding material shall be selected mineral soil meeting the requirements for backfill in Subsection 603.08. The completed bedding shall have a longitudinal camber when SHOWN ON THE DRAWINGS.

603.05
Laying Pipe

The lower segment of the pipe shall be in contact with the bedding for the required depth throughout its entire full length. Outside circumferential laps shall be placed facing upstream.

Paved or partially lined pipe shall be laid so the longitudinal centerline of the paved segment coincides with the flowline. Elliptical pipe shall be placed with the major axis within 5 degrees of a vertical plane through the longitudinal axis of the pipe.

The final installed alignment shall be such that no reverse grades exist and no point shall vary from a straight line drawn from inlet to outlet by more than 2 percent horizontally and vertically of the culvert length or 1 foot, whichever is less, unless otherwise SHOWN ON THE DRAWINGS.

No pipe shall be placed in service until a suitable outlet is provided.

Helically corrugated lock-seam pipe shall be installed with the seam at the inlet end placed below the horizontal centerline. This requirement applies to the outlet end when the outlet is less than 5 feet below subgrade.

Longitudinal laps on riveted or spot-welded pipe shall be positioned at any location between 45 degrees above or below horizontal.

603.06
Joining Pipes

Pipe shall be firmly joined by form-fitting coupling bands. End sections shall be attached to pipe by connecting bands or other means as recommended by the manufacturer. Gaskets shall be installed at each joint to form a watertight connection when SHOWN ON THE DRAWINGS. Dimpled bands shall not be used when the slope of the pipe is greater than 15 percent.

The coupling bands shall meet the strength requirements of field joints for Non-Erodible Soil Condition--Special Joint Type according to Division II, Section 23 of the "Standard Specifications for Highway Bridges" by AASHTO.

603.07
Shop Elongation

When SHOWN ON THE DRAWINGS, the vertical diameter of round pipe shall be increased 5 percent by shop elongation.

603.08
Backfilling

Pipe meeting any of the following conditions shall not be placed or backfilled until the excavation and foundation have been approved by the Engineer:

- (a) Embankment height greater than 10 feet at subgrade centerline.
- (b) Installation in a live stream.
- (c) Round pipe with a diameter of 48 inches or greater.
- (d) Pipe arches with a span of 50 inches or greater.

After the bedding is prepared and the pipe is placed, selected material shall be placed in layers not exceeding 6 inches loose thickness and compacted under the haunches and alongside the pipe. The material shall be readily compactible material free of frozen lumps, chunks of highly plastic clay (Plasticity Index greater than 10), or other objectionable material. Rocks larger than 3 inches in greatest dimension shall not be used within 1 foot of the pipe. On each side of the pipe there shall be an area of compacted material at least as wide as one diameter of the pipe. Backfill shall be compacted without damaging or displacing the pipe. The density shall be Method A or B as shown in the SCHEDULE OF ITEMS.

Method A. Backfill density shall exceed the density of the surrounding embankment.

Method B. Backfill density shall exceed 95 percent of the maximum density as determined by AASHTO T 99-Method C or D.

Backfilling and compacting shall be continued until the backfill is a minimum of 12 inches above the top of the culvert.

After being bedded and backfilled, pipe shall be protected by an adequate cover of embankment before heavy equipment is permitted to cross during roadway construction.

Pipe distorted more than 5 percent of nominal dimensions, ruptured, or broken shall be replaced.

603.09
(Reserved)

MEASUREMENT

603.10
Method

The method of measurement, as described in Section 106, will be DESIGNATED in the SCHEDULE OF ITEMS.

When shown in the SCHEDULE OF ITEMS, backfill material adjacent to the pipe will be measured 1 foot horizontally and vertically from the outside dimensions of the pipe with a deduction for the volume of the pipe along the full length of the backfill.

PAYMENT

603.11
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will made under:

<u>Pay Item</u>	<u>Pay Unit</u>
603(01) ____-Inch Corrugated Metal Pipe, ____-Inch Thickness for Steel or ____-Inch Thickness for Aluminum, Method ____	L.F.
603(02) ____-Inch Span, ____-Inch Rise, Corrugated Metal Pipe Arch, ____-Inch Thickness for Steel, or ____-Inch Thickness for Aluminum, Method ____	L.F.
603(03) ____-Inch Metal End Section	EA.
603(04) ____-Inch Span, ____-Inch Rise Metal End Section	EA.
603(05) ____-Inch Corrugated Steel Pipe, ____-Inch Thickness, Method ____	L.F.
603(06) ____-Inch Span, ____ ____-Inch Rise, Corrugated Steel Pipe Arch, ____ ____-Inch Thickness, Method ____	L.F.

603(07)	____-Inch Steel End Section	EA.
603(08)	____-Inch Span, ____-Inch Rise Steel End Section	EA.
603(09)	____-Inch ____ Type ____ Coated Corrugated Steel Pipe, ____-Inch Thickness, Method ____	L.F.
603(10)	____-Inch, ____ Type ____ Coated Paved Invert, Corrugated Steel Pipe, ____-Inch Thickness, Method ____	L.F.
603(11)	____-Inch Span, ____-Inch Rise, ____ Type ____ Coated Corrugated Steel Pipe Arch, ____-Inch Thickness, Method ____	L.F.
603(12)	____-Inch ____ Type ____ Coated Steel End Section	EA.
603(13)	____-Inch Span, ____-Inch Rise, ____ Coated Steel End Section	EA.
603(14)	____-Inch Corrugated Aluminum Pipe, ____-Inch Thickness, Method ____	L.F.
603(15)	____-Inch Paved Invert Corrugated Aluminum Pipe, ____-Inch Thickness, Method ____	L.F.
603(16)	____-Inch Span, ____-Inch Rise, Corrugated Aluminum Pipe Arch, ____-Inch Thickness, Method ____	L.F.
603(17)	____-Inch Aluminum End Section	EA.
603(18)	____-Inch Span, ____-Inch Rise Aluminum End Section	EA.
603(19)	Pipe Elbow, ____-Inch Diameter, ____-Inch Thickness	EA.
603(20)	Branch Connection, ____-Inch Diameter, ____-Inch Thickness	EA.
603(21)	Furnishing and Placing Backfill Material for Pipe	C.Y.

When materials are furnished by the Forest Service, the note
"Government-furnished materials" will be added to the description
of the pay item.

Section 603A - Concrete Pipe

DESCRIPTION

603A.01
Work This work shall consist of furnishing and installing, or installing only, concrete pipe and pipe appurtenances, including all bedding and backfilling required to complete the work.

MATERIALS

603A.02
Requirements Materials shall meet the requirements specified in the following Subsections:

Flexible Plastic Gaskets	705.09
Bituminous Mastic	705.10
Reinforced Concrete Pipe	706.02
Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe	706.14
Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe	706.15
Rubber Gaskets	705.03
Plastic Gaskets	705.11

End sections shall be constructed of the same material as the main section of the pipe.

Bedding material shall conform to the requirements of Subsection 603A.04. Backfill material shall conform to the requirements of Subsection 603A.06, or as SHOWN ON THE DRAWINGS.

The lengths and locations of individual pipe SHOWN ON THE DRAWINGS are approximate. Pipe shall not be ordered until culvert locations are DESIGNATED on the ground and a written list of the correct lengths is issued by the Engineer.

CONSTRUCTION

603A.03
Excavation Excavation shall be in accordance with the requirements of Section 206A. The trench shall be excavated a minimum of 4 inches below grade.

Pipe that is installed in or that will affect streams that are SHOWN ON THE DRAWINGS as important fisheries shall be installed only during those periods SHOWN ON THE DRAWINGS.

603A.04
Bedding Unless otherwise SHOWN ON THE DRAWINGS, the method of bedding shall consist of backfilling the trench with bedding material to grade. Bedding material shall extend to a minimum height of one-sixth the pipe diameter above the bottom of the pipe, and compacted in accordance with Subsection 603A.06.

Bedding material shall consist of select excavated material from the roadway in the vicinity of the pipe or material from the source SHOWN ON THE DRAWINGS. The material shall contain no rocks exceeding 1 inch in maximum size. The bedding surface shall provide a foundation of uniform density and support throughout the entire length of the pipe, shall provide for camber as SHOWN ON THE DRAWINGS, and shall have recesses shaped to receive the bell of bell and spigot pipe.

603A.05
Placing & Joining No pipe shall be placed or backfilled until the excavation and foundation have been approved by the Engineer and a suitable outlet has been provided. The bell or groove ends shall face upstream. The pipe section shall be joined so that the inner surfaces are reasonably flush and even, and the ends are entered as required. Joints shall be made with either a cold applied bituminous mastic, rubber, or plastic ring gaskets as SHOWN ON THE DRAWINGS. When using mastic material, the joints shall be filled with the material prior to joining the pipe.

603A.06
Backfilling

Backfill shall be readily compactible material free from frozen lumps and chunks of highly plastic clay or other objectionable material. No rock larger than 3 inches in greatest dimension shall be used within 1 foot of the pipe.

Backfill material shall be placed at or near optimum moisture content and compacted in layers not exceeding 6 inches loose thickness on both sides and to an elevation of 1 foot above the top of the pipe. Care shall be exercised to thoroughly compact the backfill under the haunches of the pipe. The backfill shall be brought up evenly on both sides of the pipe for the full length. The width of backfill on each side of the pipe shall be equal to the diameter of the pipe.

The backfill shall be compacted to at least 95 percent of the maximum density as determined by AASHTO T 99, Method C or D, unless otherwise SHOWN ON THE DRAWINGS.

Density of the compacted material will be determined during the process of the work in accordance with AASHTO T 191, T 205, or T 238; AASHTO T 217, T 239, or T 255. Corrections for coarse particles may be made in accordance with AASHTO T 224.

The final installed alignment of all pipe shall be such that no reverse grades exist, and horizontal and vertical alignments do not vary from a straight line drawn from center of inlet to center of outlet by more than 2 percent of pipe center length or 1 foot, whichever is less.

603A.07
(Reserved)

MEASUREMENT

603A.08
Method

The method of measurement, as described in Section 106, will be DESIGNATED on the SCHEDULE OF ITEMS.

When shown in the SCHEDULE OF ITEMS, backfill material adjacent to the pipe will be measured 1 foot horizontally and vertically from the outside dimensions of the pipe, with a deduction for the volume of the pipe along the full length of the backfill.

PAYMENT

603A.09
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown on the SCHEDULE OF ITEMS. Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
603A(01) ____ -Inch, Reinforced Concrete Pipe, Class 	L.F.
603A(02) ____ -Inch Span, ____ -Inch Rise Reinforced Concrete Pipe, Class ____	L.F.
603A(03) ____ -Inch, Reinforced Concrete End Section . .	EA.
603A(04) ____ -Inch Span, ____ -Inch Rise Reinforced Concrete End Section	EA.
603A(05) Furnishing and Placing Backfill Material for Pipe	C.Y.

When materials are furnished by the Forest Service, the note "Government-furnished materials" will be added to the description of the pay item.

Section 603B - Corrugated Polyethylene Pipe

DESCRIPTION

603B.01
Work This work shall consist of furnishing and installing, or installing only, polyethylene pipe and pipe appurtenances, including all bedding and backfilling required to complete the work.

MATERIALS

603B.02
Requirements Materials shall meet the requirements of the following Subsections:

Corrugated Polyethylene Pipe,	
12- to 24-Inch Diameter	706.20
Rubber Gaskets	705.03

Bedding material shall meet the requirements of Subsection 603B.04, or as SHOWN ON THE DRAWINGS.

Backfill materials shall meet the requirements of Subsection 603B.06, or as SHOWN ON THE DRAWINGS.

The lengths and locations of individual pipe SHOWN ON THE DRAWINGS are approximate. Pipe shall not be ordered until culvert locations are DESIGNATED on the ground and a written list of the correct lengths is issued by the Engineer.

CONSTRUCTION

603B.03
Excavation Excavation shall be in accordance with the requirements of Section 206A. The excavation shall be a minimum of 8 inches below the designed invert elevation.

Pipe that is installed in or that will affect streams that are SHOWN ON THE DRAWINGS as important fisheries shall be installed only during those periods SHOWN ON THE DRAWINGS.

603B.04
Bedding Bedding shall consist of placing bedding material in the excavated section and compacting the material to ensure a uniform foundation bed for the pipe.

The bedding material shall be selected mineral soil meeting the requirements for backfill in Subsection 603B.06.

The completed bedding shall have a longitudinal camber when SHOWN ON THE DRAWINGS.

603B.05
Placing & Joining Pipe shall be firmly jointed by form-fitting corrugated coupling bands matching the pipe corrugations. Rubber gaskets shall be on each joint to form a watertight connection when SHOWN ON THE DRAWINGS.

Protection of portions of the pipe that will be exposed shall be accomplished when SHOWN ON THE DRAWINGS.

The final installed alignment shall be such that no reverse grades exist and no point shall vary from a straight line drawn from center of inlet to center of outlet by more than 2 percent horizontally and vertically of the culvert length or 1 foot, whichever is less, unless otherwise SHOWN ON THE DRAWINGS.

Pipe meeting any of the following conditions shall have the pipe bed approved by the Engineer prior to placing the pipe:

- (a) Embankment height greater than 10 feet at subgrade centerline.
- (b) Installation in a live stream.

603B.06
Backfilling Backfill shall be readily compactible material, free from frozen lumps and chunks of highly plastic clay (plasticity index greater

than 10) or other objectionable material. No rocks larger than 1 inch in greatest dimension shall be used within 1 foot of the pipe.

Backfill material shall be placed at or near optimum moisture content and compacted in layers not exceeding 6 inches loose thickness on both sides and to an elevation of 1 foot minimum above the top of the pipe. Care shall be exercised to thoroughly compact the backfill under the haunches of the pipe. The backfill shall be brought up evenly on both sides of the pipe for the full length. The width of the compacted backfill shall extend a minimum of 1 foot on each side of the pipe.

The density shall be Method A or B as shown in the SCHEDULE OF ITEMS.

Method A. Backfill density shall exceed the density of the surrounding embankment.

Method B. Backfill density shall exceed 95 percent of the maximum density as determined by AASHTO T 99, Method C or D.

After being bedded and backfilled, pipe shall be protected by an adequate cover of embankment before heavy equipment is permitted to cross during roadway construction.

Pipe distorted more than 5 percent of nominal dimensions, ruptured, or broken shall be replaced.

603B.07
(Reserved)

MEASUREMENT

603B.08
Method

The method of measurement, as described in Section 106, will be DESIGNATED in the SCHEDULE OF ITEMS.

When shown in the SCHEDULE OF ITEMS backfill material adjacent to the pipe will be measured 1 foot horizontally and vertically from the outside dimensions of the pipe with a deduction for the volume of the pipe along the full length of the backfill.

PAYMENT

603B.09
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown on the SCHEDULE OF ITEMS. Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
603B(01) -Inch, Corrugated Polyethylene Pipe Method A	L.F.
603B(02) -Inch, Corrugated Polyethylene Pipe Method B	L.F.
603B(03) Furnishing and Placing Backfill Material for Pipe	C.Y.

When materials are furnished by the Forest Service, the note "Government-furnished materials" will be added to the description of the pay item.

Section 604 - Manholes, Inlets, & Catch Basins

DESCRIPTION

604.01 This work shall consist of the construction and installation of
Work manholes, inlets, and catch basins.

MATERIALS

604.02 Concrete shall meet the requirements of Section 602. Concrete
Requirements composition shall be Method A or B as SHOWN ON THE DRAWINGS.
 Other materials shall meet the requirements of the following
 Subsections:

Clay or Shale Brick	704.01
Concrete Brick	704.02
Concrete Masonry Blocks	704.03
Joint Fillers	705.01
Joint Mortar	705.02
Rubber Gaskets	705.03
Zinc Oxide Paint	708.03
Reinforcing Steel	709.01
Welded Wire Fabric	709.01
Precast Concrete Units	712.07
Frames, Grates and Covers, and Ladder Rungs	712.08
Corrugated Metal Units	712.09

Welding shall be done in accordance with the best modern practice and applicable requirements of AWS D1.1.

Metal drop inlets shall be fabricated of the same type of material and shall have the same coatings as the culvert on which they are to be placed.

CONSTRUCTION

604.03 Concrete construction shall meet the requirements of Section 602.
Performance Concrete units may be cast-in-place or precast.

Joints for precast concrete manhole sections shall be made with Portland cement mortar, rubber gaskets, mastic joint fillers, or by a combination of these types to form a water-tight seal.

Metal frames shall be set in a full mortar bed. Pipe sections smaller in diameter than the structure shall be flush on the inside of the structure wall and project outside enough for proper connection with the next pipe section. Pipe sections larger in diameter than the structure shall be constructed as monolithic tee sections. Masonry shall fit neatly and tightly around the pipe.

When grade adjustment of existing structures is required, the frames, covers, and gratings shall be removed and the walls reconstructed as required. The cleaned frames shall be reset at the required elevation. After completion, each structure shall be cleaned of any accumulation of silt, debris, or other foreign matter and kept clean of these accumulations.

Excavation and backfill shall be in accordance with Section 206A.

MEASUREMENT

604.04 The method of measurement, as described in Section 106, will be
Method DESIGNATED in the SCHEDULE OF ITEMS.

Manholes, inlets, and catch basins, new and reconstructed, will be divided into two types.

Type 1. Structures connected to pipe 42 inches or less in diameter, regardless of the pipe skew.

Type 2. Structures connected to pipe 48 inches in diameter or larger, regardless of the pipe skew.

"Manhole Additional Depth" will be in linear feet, and is defined as that depth exceeding the upper 6 feet. "Manhole Additional Depth" shall be classed as follows:

- (a) Class 1. Manholes 10 linear feet or less in depth.
- (b) Class 2. Manholes exceeding 10 linear feet but not exceeding 20 linear feet in depth.

PAYMENT

604.05
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
604(01) Manhole, Type _____	EA.
604(02) Inlets, Type _____	EA.
604(03) Catch Basins, Type _____	EA.
604(04) Manhole, Type _____, Additional Depth, Class _____	L.F.

Section 605 - Underdrains

DESCRIPTION

605.01 This work shall consist of furnishing and installing, or
Work installing only, underdrains using geotextile, pipe, and granular
 filter material; underdrain pipe outlets; and blind drains using
 granular filter material, with or without geotextile.

MATERIALS

605.02 Materials shall meet the requirements of the following Section or
Requirements Subsections:

Granular Backfill Filter Material	703.01(b)
Perforated Concrete Pipe	706.03
Drain Tile	706.04
Porous Concrete Pipe	706.05
Clay Pipe	706.07
Cradle Invert Clay Pipe	706.09
Asbestos Cement Pipe	706.10
Perforated Asbestos Cement Pipe	706.11
Bituminized-Fiber Pipe	706.12
Perforated Bituminized-Fiber Pipe	706.13
Polyvinylchloride (PVC) Drainage Pipe (Slot Perforated or Nonperforated)	706.17
Corrugated Polyethylene (PE) Drainage Pipe (Slot Perforated or Nonperforated)	706.18
Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings	706.19
Polymeric-Precoated Steel Pipe for Underdrains	707.03
Corrugated Steel Pipe for Underdrains, Plain Galvanized or Precoated	707.04
Bituminous-Coated Corrugated Steel Pipe for Underdrains	707.05
Corrugated Aluminum Alloy Pipe for Underdrains	707.07
Bituminous-Coated Corrugated Aluminum Alloy Pipe Underdrain	707.09
Aluminum-Coated Type 2 Corrugated Steel Pipe for Underdrains	707.13
Aluminum-Zinc-Alloy-Coated Corrugated Steel Pipe and Pipe Arches	707.14
Bituminous-Coated Polymeric-Precoated Steel Pipe, Pipe Arches, and Underdrains	707.15
Geotextiles	720

Granular filter material gradation will be SHOWN ON THE DRAWINGS.

When material is furnished by the contractor, a manufacturer's Certificate of Compliance shall be furnished to the Engineer. Only one type of pipe material shall be used in any one underdrain installation. Outlet pipe for underdrains shall be nonperforated or perforated pipe of like diameter or larger. When slot-perforated pipe is required, the size and spacing of the slots shall be as SHOWN ON THE DRAWINGS.

During shipment and storage, geotextile shall be wrapped in burlap or similar heavy-duty protective covering. The storage area shall provide protection from mud, dirt, dust, debris, and direct sunlight.

CONSTRUCTION

605.03 Excavated material from trenches covered in this section shall be
Trenches utilized or disposed of as SHOWN ON THE DRAWINGS.

605.04 Trenches shall be excavated to the dimensions and grades SHOWN ON
Pipe Installation THE DRAWINGS and as adjusted to meet field conditions. A minimum

4-inch bedding layer of granular filter material shall be placed and compacted in the bottom of the trench for its full width and length.

Underdrain pipe shall be embedded firmly in the bedding material.

Perforated pipe shall be placed with the perforations down. The pipe section shall be joined securely with coupling fittings or bands.

Nonperforated pipe shall be laid with the bell end up grade and with open joints wrapped with suitable material to permit entry of water, or unwrapped as SHOWN ON THE DRAWINGS. Upgrade end sections of all subdrainage pipe installations shall be plugged to prevent entry of soil materials.

After the pipe installation has been inspected and approved by the Engineer, granular filter material shall be placed, without compaction, to a height of 1 foot above the top of the pipe. contractor shall not displace the pipe or the covering at open joints. The remainder of the granular filter backfill material shall then be placed and compacted in layers not exceeding 6 inches loose thickness. Any remaining portion of trench above the granular filter backfill shall be filled with either granular or impervious material, as SHOWN ON THE DRAWINGS, and compacted.

605.05
Underdrain
Outlets

Trenches for underdrain outlets shall be excavated to the width and depth SHOWN ON THE DRAWINGS and adjusted to meet field conditions. Pipe shall be laid in the trench with all ends firmly joined. After inspection and approval by the Engineer of the pipe installation, the trench shall be backfilled in accordance with Subsection 603.08, Method A.

605.06
Blind Drains

Trenches for blind drains shall be excavated to the width and depth SHOWN ON THE DRAWINGS. The trench shall be filled with granular backfill material of the size, type, and depth SHOWN ON THE DRAWINGS. Any remaining upper portion of trench shall be backfilled using approved material provided from borrow or excavation.

605.07
Geotextile

The geotextile shall be placed in the manner and at the locations SHOWN ON THE DRAWINGS. The surface to receive geotextile shall be prepared to a relatively smooth condition that is free of obstructions, depressions, and debris. The geotextile shall be laid loosely without wrinkles or creases.

The geotextile strips shall be overlapped a minimum of 1 foot at joints. Securing pins shall be inserted through both strips of overlapped geotextile at maximum intervals of 3 feet.

Securing pins shall be installed as necessary to prevent slippage of the geotextile and to attach the geotextile to the foundation.

The installed geotextile shall be approved by the Engineer prior to covering or backfilling.

The geotextile shall be protected from contamination and damage during installation of other materials. Granular filter material shall be carefully placed on the geotextile by methods that will not cause damage to the geotextile.

MEASUREMENT

605.08
Method

The method of measurement, as described in Section 106, will be DESIGNATED in SCHEDULE OF ITEMS. Geotextile material will be measured on surface area covered according to the dimensions SHOWN ON THE DRAWINGS.

PAYMENT

605.09
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS. The term "metal" refers collectively to aluminum and steel. Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
605(01) <u> </u> -Inch, Perforated Corrugated Metal Pipe	L.F.
605(02) <u> </u> -Inch, Nonperforated Corrugated Metal Pipe	L.F.
605(03) <u> </u> -Inch, Perforated Corrugated Steel Pipe	L.F.
605(04) <u> </u> -Inch, Nonperforated Corrugated Steel Pipe	L.F.
605(05) <u> </u> -Inch, <u> </u> Coated Perforated Corrugated Steel Pipe	L.F.
605(06) <u> </u> -Inch, <u> </u> Coated Nonperforated Corrugated Steel Pipe	L.F.
605(07) <u> </u> -Inch, Perforated Concrete Pipe, Class <u> </u>	L.F.
605(08) <u> </u> -Inch, Concrete Drain Tile, Class <u> </u>	L.F.
605(09) <u> </u> -Inch, Perforated Asbestos Cement Pipe	L.F.
605(10) <u> </u> -Inch, Nonperforated Asbestos Cement Pipe	L.F.
605(11) <u> </u> -Inch, Perforated Clay Pipe, Class <u> </u>	L.F.
605(12) <u> </u> -Inch, Nonperforated Clay Pipe, Class <u> </u>	L.F.
605(13) <u> </u> -Inch, Cradle-Invert Clay Pipe	L.F.
605(14) <u> </u> -Inch, Perforated Bituminized- Fiber Pipe, Type <u> </u>	L.F.
605(15) <u> </u> -Inch, Nonperforated Bituminized- Fiber Pipe, Type <u> </u>	L.F.
605(16) <u> </u> -Inch, Perforated Corrugated Aluminum Pipe	L.F.
605(17) <u> </u> -Inch, Nonperforated Corrugated Aluminum Pipe	L.F.
605(18) <u> </u> -Inch <u> </u> Pipe	L.F.
605(19) Blind Drain	L.F.
605(20) Pipe Elbow <u> </u> x <u> </u>	EA.
605(21) Pipe Tee, Size <u> </u>	EA.
605(22) Granular Filter Material	C.Y.
605(23) Granular Filter Material	TON

605(24) Granular Filter Material L.F.

605(25) Geotextile (Underdrain Function) S.Y.

When materials are furnished by the Forest Service, the note
"Government-furnished materials" will be added to the description
of the pay item.

Section 606 - Guardrail

DESCRIPTION

606.01 This work shall consist of furnishing and installing guardrail.
Work

MATERIALS

606.02 Materials shall meet the requirements of the following Subsections:
Requirements

Wire Rope or Wire Cable	709.02
Chain Link Fabric	710.03
Metal Beam Rail	710.04
Timber Rail	710.05
Guardrail Posts	710.07
Guardrail Hardware	710.08
Box Beam Rail	710.09
Concrete	602.03

High-strength, unpainted, ungalvanized, weathering steel shall meet the following requirements:

(a) AASHTO M 180 Type 4.

(b) Two to six times the resistance to atmospheric corrosion of carbon steel and able to develop a tightly adherent, impervious, oxide coating as the steel weathers.

High tensile strength bolts for weathering-steel guardrail shall meet the mechanical properties of AASHTO M 164, Type 3.

CONSTRUCTION

606.03 Posts shall be plumb. Posts shall not be battered or distorted
Posts when driven. Post holes shall be backfilled with acceptable material placed in layers of not more than 4 inches loose thickness and thoroughly compacted. When it is necessary to cut post holes in existing pavement, all loose material shall be removed and the pavement replaced in kind.

606.04 The class and type of rail elements shall be as SHOWN ON THE
Rail Elements DRAWINGS. The installation shall be smooth and continuous with laps in the direction of traffic flow. All bolts, except adjustment bolts, shall be drawn tight. Bolts shall be of sufficient length to extend beyond the nuts by not more than 1 inch. Rails shall be shop bent for curves with 150-foot radius or less.

Galvanized surfaces that have been abraded to expose the base metal, threaded portions of all fittings and fasteners, and cut ends of bolts shall be cleaned and coated with a commercially available, zinc-rich paint (pure zinc in vehicle).

When concrete anchors are poured in place, the anchors shall not be connected to the guardrail until 7 days after the concrete has been placed. Concrete shall meet the requirements of Section 602, Method A or B as SHOWN ON THE DRAWINGS.

MEASUREMENT

606.05 The method of measurement, as described in Section 106, will be
Method DESIGNATED in the SCHEDULE OF ITEMS.

The length of guardrail will be from end to end of the rail except where end connections are made to concrete or steel structures, in which case the length will be to the face of these structures. Double-faced rail attached to the same post will be measured as a single unit.

The quantity of end anchorages and terminal sections will be the number of units of each kind specified and installed. Guardrail length will not include end anchorage or terminal sections.

PAYMENT

606.06
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment shall be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
606(01) Rustic Guardrail	L.F.
606(02) Untreated Wood Guardrail	L.F.
606(03) Preservative-Treated Wood Guardrail	L.F.
606(04) Box Beam-Type Guardrail, Class _____	L.F.
606(05) Galvanized _____, Beam-Type Guardrail, Class _____, Type _____	L.F.
606(06) High-Strength Weathering Beam-Type Guardrail, Class _____, Type _____	L.F.
606(07) End Anchorage, Type _____	EA.
606(08) Terminal Section, Type _____	EA.

Section 607 - Fences, Gates, & Cattleguards

DESCRIPTION

607.01 This work shall consist of furnishing and installing, or installing
Work only, fences, gates, and cattleguards.

MATERIALS

607.02 Materials shall meet the requirements of the following Sections and
Requirements Subsections:

Barbed Wire	710.01
Woven Wire	710.02
Chain Link Fabric	710.03
Timber Rails.	710.05
Fence Posts	710.06
Material for Timber Structures	716
Structural Metal	717

Materials may be approved by the Engineer based upon the manufacturer's Certificate of Compliance.

Materials for gates and cattleguards shall meet the requirements as SHOWN ON THE DRAWINGS. Concrete for cattleguard units may be cast-in-place or precast. Concrete shall meet the requirements of Section 602, Method A or B as SHOWN ON THE DRAWINGS.

CONSTRUCTION

607.03 Trees, brush, and other obstacles along the fence line that
Fences & Gates interfere with the fence shall be removed. Continuous grubbing or grading along the fence line shall not be done. Where possible, the fence shall be erected on natural ground. The clearing width and disposal of materials shall be as SHOWN ON THE DRAWINGS.

When drilling into solid rock is required to set a post, the post may be shortened, provided a minimum of 12 inches of post is grouted into the rock.

Where breaks in a run of fencing are required, or at intersections with existing fences, post spacing shall be adjusted to meet the requirements for the type of closure.

When posts, braces, or anchors are to be imbedded in concrete, temporary guys or braces shall be installed as required to hold the posts in proper position until the concrete has set. No materials shall be installed on posts or strain placed on guys and bracing set in concrete until 7 days have elapsed from the time the concrete was placed.

All posts shall be set vertically and to the grade and alignment SHOWN ON THE DRAWINGS. Tops of posts shall not be cut unless approved by the Engineer.

Wire or fencing shall be stretched taut and firmly attached to the posts and braces as SHOWN ON THE DRAWINGS.

At each location where an electric line crosses a fence containing metal, grounding of the fencing shall be accomplished in accordance with the following: A galvanized or copper-coated steel grounding rod 8 feet long with a minimum diameter of 1/2 inch shall be installed directly below the point of crossing. The rod shall be driven vertically until the top is 6 inches below the ground surface. A Number 6 solid copper conductor or equivalent shall be used to connect each metal fence element to the grounding rod. The connections shall be either brazed or fastened with noncorrosive clamps approved by the Engineer.

When a powerline is within 500 feet and runs parallel or nearly parallel to the fence, the fence shall be grounded at each end, at gate posts, and at intervals not to exceed 1,500 feet.

When acceptable vertical penetration of the grounding rod cannot be obtained, an equivalent horizontal grounding system shall be submitted by the contractor for approval by the Engineer.

The bottom of the fence fabric shall generally follow the contour of the ground. Grading shall be performed where necessary to provide a neat appearance. Where abrupt changes in the ground profile make it impractical to maintain the specified ground clearance, longer posts may be used and multiple strands of barbed wire stretched thereon. The vertical spacing between strands of barbed wire shall be 6 inches unless otherwise SHOWN ON THE DRAWINGS. At grade depressions, where stresses tend to pull posts from the ground, sag bracing shall be installed as SHOWN ON THE DRAWINGS.

Wire splicing shall be as SHOWN ON THE DRAWINGS.

All posts shall be repaired in accordance with approved procedures after cutting or drilling.

607.04
Cattleguards

Work required under Section 203 or 306 shall be completed at the location of the cattleguard before excavation for the cattleguard is started. Cattleguard shall be installed at grade elevation SHOWN ON THE DRAWINGS or staked on the ground. Drainage shall be provided at time of installation so cattleguard will drain. Bypass and gate shall be constructed as SHOWN ON THE DRAWINGS.

Excavation shall be in accordance with Section 206A.

After cattleguard is bedded, selected material shall be placed in layers not exceeding 6 inches loose thickness, compacted alongside the cattleguard uniformly on all sides. Backfill shall be readily compactible material, free of frozen lumps, chunks of highly plastic clay, or other objectional material. Backfill shall be compacted without damaging or displacing the cattleguard. Backfilling and compacting shall be continued to the top of the cattleguard foundation.

After being bedded and backfilled, the cattleguard shall be protected by adequate ramps on each side, before heavy equipment is permitted to cross during roadway construction.

MEASUREMENT

607.05
Method

The method of measurement as described in Section 106 will be DESIGNATED in the SCHEDULE OF ITEMS.

Fence length will be along the top of the fence from outside to outside of end posts for each continuous run of fence.

When brace panels and by-pass gates are SHOWN ON THE DRAWINGS, payment for cattleguards shall include these items.

PAYMENT

607.06
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
607(01) Cattleguard, _____ Foundation, Loading _____, Width _____	EA.

607(02) Fence _____, Type _____,
Height _____ L.F.

607(03) Gate _____, Type _____,
Size _____ EA.

When materials are furnished by the Forest Service, the note
"Government-furnished materials" will be added to the description
of the pay item.

Section 608 - Sidewalks

DESCRIPTION

608.01 This work shall consist of the construction of bituminous or Portland cement concrete sidewalks.

MATERIALS

608.02 Materials shall meet the requirements of the following Subsections:
Requirements

Bed Course Material	703.15
Joint Fillers	705.01
Reinforcing Steel	709.01

Concrete for sidewalks shall meet the requirements of Section 602, Method A or B, as SHOWN ON THE DRAWINGS.

Materials for bituminous sidewalks shall meet the requirements of Section 403 or 406.

Bituminous mixes will be subject to inspections and tests at the mixing plants for compliance with quality requirements.

CONSTRUCTION

608.03 Portland Cement Concrete Sidewalks

(a) Excavation. Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms for the section SHOWN ON THE DRAWINGS. The foundation shall be shaped and compacted to a firm, even surface. All soft and yielding materials shall be removed and replaced with acceptable material.

(b) Forms. Forms shall be made of wood, metal, or other suitable material and shall extend to the full depth of the concrete. All forms shall be straight, free from warp, and strong enough to resist the pressure of the concrete without displacement. Bracing and staking of forms shall keep the forms in horizontal and vertical alignment until their removal. All forms shall be cleaned and coated with an approved form-release agent before concrete is placed. After the forms have been set to line and grade, the foundation shall be brought to the required grade and wetted, approximately 12 hours before placing the concrete. Machine slip forming may be used.

(c) Placing Concrete. The foundation shall be thoroughly moistened immediately before placing the concrete. The proportioning, mixing, and placing of the concrete shall be in accordance with the requirements of Section 602 for the concrete method used and shall be deposited without segregation in one course.

(d) Finishing. The concrete shall be struck off with a straightedge and finished to a smooth, uniform texture by troweling and floating. The surfaces shall be crossbroomed, burlap-finished, lightly grooved, or marked into squares or other shapes as SHOWN ON THE DRAWINGS.

All outside edges of the slab and all joints shall be edged with a 1/4 inch radius edging tool.

(e) Joints. Expansion joints and joint filler shall be as SHOWN ON THE DRAWINGS. The sidewalk shall be divided into sections by dummy joints formed by a jointing tool or sawing. The dummy joints shall extend into the concrete at least one-fourth to one-fifth of the depth and shall be approximately 1/8 inch wide. Joints shall match as nearly as possible adjacent joints in curb or pavements.

Construction joints shall be formed around all appurtenances, such as manholes, utility poles, and so forth, which extend into and through the sidewalks. Premolded expansion joint filler 1/2 inch thick shall be installed in these joints. Expansion joint filler shall be installed between concrete sidewalks and any fixed structure such as a building or bridge. This expansion joint material shall extend to the full depth of the walk.

(f) Curing. Concrete shall be cured by application of a Type 1-D liquid membrane-forming compound applied uniformly to damp concrete by pressure spray methods, or by keeping the concrete moist with burlap or mats for at least 72 hours. All materials shall meet the requirements of Section 711.

During the curing period, all traffic, both pedestrian and vehicular, shall be excluded. Vehicular traffic shall be excluded for such additional times as the Engineer may direct.

608.04
Bituminous Concrete
Sidewalks

(a) Excavation and Forms. Excavation and forms shall meet the requirements of Subsection 608.03(a) and Subsection 608.03(b), except wetting will not be required under the latter.

(b) Bed Course. Bed course material shall be placed in layers not exceeding 4 inches loose depth, and each layer shall be thoroughly compacted to a firm even surface.

(c) Placing Bituminous Sidewalk Materials. The mixture shall be placed only when the bed is dry and weather conditions are suitable for the proper handling and finishing of the mixture. Bituminous sidewalk material shall be placed on the compacted bed course in one or more courses as SHOWN ON THE DRAWINGS so as to give the required depth when rolled. Compaction shall be accomplished by means of a type of power compactor. In areas inaccessible to the roller, hand tamping will be permitted. In any case, the bituminous sidewalk material shall be uniformly compacted.

MEASUREMENT

608.05
Method

The method of measurement, as described in Section 106, will be DESIGNATED in the SCHEDULE OF ITEMS.

PAYMENT

608.06
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
608(01) Portland Cement Concrete Sidewalk	S.Y.
608(02) Bituminous Concrete Sidewalk	TON
608(03) Bituminous Concrete Sidewalk	S.Y.
608(04) Bed Course Material	TON
608(05) Bed Course Material	S.Y.

Section 609 - Curb or Curb & Gutter

DESCRIPTION

609.01
Work

This work shall consist of the construction or resetting of curb, gutter, or combination curb and gutter.

MATERIALS

609.02
Requirements

Materials shall meet the requirements of the following Sections and Subsections:

Bituminous Materials (for tack coat)	702
Bed Course Material	703.15
Joint Fillers	705.01
Joint Mortar	705.02
Reinforcing Steel	709.01
Stone Curbing	712.05
Precast Concrete Curbing	712.06

Concrete shall meet the requirements of Section 602, Method A or B as SHOWN ON THE DRAWINGS.

Bituminous mixtures as SHOWN ON THE DRAWINGS shall meet the requirements of Section 403 or 406.

Concrete, bituminous mixes, and manufactured curbing materials will be subject to inspection and tests at the plants for compliance with quality requirements.

CONSTRUCTION

609.03 Cast-in-Place Portland Cement Concrete Curbing or Curb & Gutter

(a) Excavation. Excavation shall be made to the depth SHOWN ON THE DRAWINGS. The foundation shall be compacted to a firm even surface. All soft, yielding material shall be removed and replaced with acceptable material.

(b) Forms. Forms shall be made of wood, metal, or other suitable material and shall extend to the full depth of the concrete. All forms shall be straight, free of warp, and of sufficient strength to resist the pressure of the concrete without displacement. Bracing and staking of forms shall keep the forms in both horizontal and vertical alignment until their removal. All forms shall be cleaned and coated with an approved form-release agent before concrete is placed. Divider plates shall be of metal. After the forms have been set to line and grade, the foundation shall be brought to the grade required and well wetted approximately 12 hours before placing the concrete. Machine slip forming may be used.

(c) Mixing and Placing. Concrete shall be proportioned, mixed, and placed in accordance with the requirements of Section 602 Method A or B, as described in Section 602, as SHOWN ON THE DRAWINGS, and shall be deposited without segregation in one course. Consolidation of concrete placed in the forms shall be by vibration or other acceptable methods. Forms shall be left in place for 24 hours or until the concrete has set sufficiently so that they can be removed without injury to the curbing. The concrete shall be struck off to the cross section SHOWN ON THE DRAWINGS, after which it shall be finished smooth and even by means of a wooden float.

For the purpose of matching adjacent concrete finishes or for other reasons, the Engineer may permit other methods of finishing. No plastering will be permitted.

(d) Contraction Joints. Curbing shall be constructed in sections having a uniform length of 10 feet unless otherwise approved by the Engineer. Sections shall be separated by open joints

approximately 1/8-inch wide and at least 1-inch deep, except at expansion joints. Where the curb is constructed adjacent to concrete pavement, the contraction or open joints in the curb shall match the contraction joints in the pavement.

(e) Expansion Joints. Expansion joints shall be formed at the intervals SHOWN ON THE DRAWINGS using a preformed expansion joint filler having a thickness of 1/2 inch. When the curb is constructed adjacent to or on concrete pavement, expansion joints shall be located at expansion joints in the pavement.

(f) Curing. Immediately upon completion of the finishing, the curbing shall be moistened and kept moist for 3 days, or the curbing shall be cured by the use of membrane forming material. All materials shall meet the requirements of Section 711.

(g) Backfilling. After the concrete has set sufficiently, the curb shall be backfilled to the required elevation with suitable material, which shall be compacted in accordance with Subsection 203.15(b), Method 4, in layers of not more than 6 inches loose thickness.

(h) Curb Machine. The curb or curb and gutter may be constructed by the use of a curb forming machine meeting the requirements of Subsections 609.06(c), 1 and 2.

(i) Curb Template. Exposed curb face may be constructed and finished by use of trowel-type templates, shaped to produce the desired contours when operated along approved forms set to the established lines and grades.

While the concrete is green, the top, front, or other exposed surfaces of the curb or combined curb and gutter shall be floated with a moist wooden float. Form marks and any other irregularities shall be removed.

609.04
Precast Concrete
Curbing

The curb shall be set so that the top surfaces of adjoining sections are true and even. All spaces under the curbing shall be filled with material meeting the requirements of the material for bed course, and this material shall be compacted.

609.05
Reflecting
Concrete Curbing

Construction methods for this item shall meet the requirements of Subsection 609.03, with the following exceptions:

The reflecting surface of the curbing shall be a mortar mix consisting of one part white Portland cement to 1.75 parts of light-colored, washed mortar sand. This mortar mix shall have a thickness of approximately 1 inch.

Alternatively, the entire curbing may be constructed of concrete with white Portland cement.

Washed mortar sand shall meet all the requirements for mortar sand and shall be of a light color. The reflecting surface mortar shall be placed immediately after placing of the base concrete. In no case shall more than 20 minutes elapse between the placing of the base concrete and the placing of the reflecting surface.

Scoring or surface deformation and finish of the reflecting surface shall be in accordance with the details SHOWN ON THE DRAWINGS.

609.06
Bituminous
Concrete Curbing

(a) Excavation. Excavation shall meet the requirements of Subsection 609.03(a).

(b) Preparation of Bed. When curbing is to be constructed on a cured or aged Portland cement concrete base, on bituminous pavement, or on a bituminous-treated base, the bed shall be thoroughly swept and cleaned by compressed air. The surface shall be thoroughly dried and, immediately before placing of the

bituminous mixture, shall receive a tack coat of bituminous materials of the type and grade SHOWN ON THE DRAWINGS. The rate of application of the tack coat material shall be between 0.05 and 0.15 gallon per square yard of surface. The contractor shall prevent the tack coat from spreading to areas outside of the area to be occupied by the curb.

(c) Placing. Bituminous curbing shall be constructed by use of a self-propelled, automatic curber or curb machine or a paver with curbing attachments. The automatic curber or machine shall meet the following requirements:

(1) The weight of the machine shall be such that compaction is obtained without the machine riding above the bed on which curbing is constructed.

(2) The machine shall form curbing that is uniform in texture, shape, and density.

(3) The construction of curbing by means other than the automatic curber or machine are acceptable when short sections or sections with short radii are required. The resulting curbing shall conform in all respects to the curbing produced by the use of the machine.

The mixture shall be placed only when the bed is dry and weather conditions are suitable for the proper handling and finishing of the mixture.

The bituminous mixture shall be placed at a workable temperature of not less than 225 °F. The curbs shall be placed to an accurate alignment and shall have a high density free of honeycombs. When joining to a section of curb that has become cold, the contact surface of the cold curb shall be given a thin uniform tack coat of bituminous material prior to placing the fresh bituminous mixture against the cold joint. The curbs shall be protected from traffic by barricades or other suitable method until the curb has hardened.

(d) Painting and Sealing. Sealing or painting shall be performed only on a curbing that is clean and dry and that has reached an ambient temperature.

(e) Backfilling. Backfilling shall meet the requirements of Subsection 609.03(g).

609.07
Resetting Curb

(a) Salvage of Curbing. Curbing specified for resetting shall be carefully removed, stored, and cleaned. The contractor shall replace any existing curbing that is to be reset, lost from storage, or damaged through improper handling.

(b) Excavation. Excavation and bedding shall meet the requirements of Subsection 609.03(a).

(c) Resetting Curb. The curb shall be set on a firm bed with the top surface of adjoining sections true and even. All sections of curbing shall be set so that the maximum opening between adjacent sections is not more than 3/4 inch wide for the entire exposed top and face. The ends of the curbing shall be dressed as necessary to meet this requirement.

After the curb has been set, the joints shall be completely filled with mortar as SHOWN ON THE DRAWINGS.

(d) Backfilling. The curb shall be backfilled to the required elevation with suitable material. This material shall be thoroughly tamped in layers of not more than 6 inches loose thickness.

(e) Cutting and Fitting. Cutting or fitting shall be done as necessary to install the curbing.

MEASUREMENT

609.08
Method

The method of measurement, as described in Section 106, will be DESIGNATED in the SCHEDULE OF ITEMS.

Curbing will be measured along the front face of the section at the finished grade elevation. The length of combination curb and gutter will be measured along the face of the curb. No deduction in length will be made for drainage structures installed in the curbing section or for driveway openings where the gutter is carried across the drive.

PAYMENT

609.09
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
609(01) Portland Cement Concrete Curb, _____-Inch Depth, Type _____	L.F.
609(02) Portland Cement Concrete Gutter, Type _____	L.F.
609(03) Portland Cement Concrete Curb and Gutter, _____ Inch Depth, Type _____	L.F.
609(04) Bituminous Concrete Curb, _____-Inch Depth	L.F.
609(05) Reset Curb	L.F.
609(06) Bed Course Material	TON
609(07) Bed Course Material	C.Y.

Section 610 - Stone Masonry Structures

DESCRIPTION

- 610.01 Work This work shall consist of the construction of stone masonry structures and stone masonry portions of composite structures.
- 610.02 Classes of Masonry The class of masonry required for each part of a structure will be SHOWN ON THE DRAWINGS.
- Cement rubble masonry shall consist of roughly dressed stones of various sizes and shapes laid in random courses in cement mortar.
- Class A and Class B masonry shall consist of stones shaped, dressed, and laid broken-coursed in cement mortar.
- Dimensioned masonry shall consist of broken-coursed ashlar masonry composed of stones having two or more dimensions SHOWN ON THE DRAWINGS.

MATERIALS

- 610.03 Stone The stone shall be sound and durable. Stone for dimensioned masonry shall be free of reeds, rifts, seams, laminations, and minerals that, by weathering, would cause discoloration or deterioration.
- (a) Sizes and Shapes. Stones shall be furnished in the sizes and face areas necessary to produce the general characteristics and appearance as SHOWN ON THE DRAWINGS.
- In general, stones shall have a thickness not less than 5 inches, a width not less than one and one-half times their thickness, with a minimum width of 12 inches, and a length of not less than one and one-half times their width. Where headers are required, their lengths shall be not less than the width of the bed of the widest adjacent stretcher plus 12 inches.
- At least 50 percent of the total volume of the masonry shall be stones having a volume of at least 1 cubic foot each.
- (b) Dressing. The stone shall be dressed to remove any thin or weak portions. Face stones shall be dressed to provide bed and joint lines with a maximum variation from true line as follows:
- | Type of Masonry | Maximum Variation |
|-----------------------|-------------------|
| Cement rubble masonry | 1-1/2 inches |
| Class A masonry | 3/4 inch |
| Class B masonry | 1/4 inch |
| Dimensioned masonry | Reasonably true |
- (c) Bed Surfaces. Bed surfaces of face stones shall be normal to the faces of the stones for about 3 inches and from this point may depart from normal not to exceed 1 inch in 12 inches for dimensioned masonry and 2 inches in 12 inches for all other classes.
- (d) Joint Surfaces. In all classes of masonry except dimensioned masonry, the joint surfaces of face stones shall form an angle with the bed surfaces of not less than 45 degrees.
- In dimensioned masonry, the joint surfaces shall be normal to the bed surfaces. They shall also be normal to the exposed faces of the stone for at least 2 inches, from which point they may depart from normal by not more than 1 inch in 12 inches.
- The corners at the meeting of the bed and joint lines shall not be rounded in excess of the following radii:

Type of Masonry	Dimensions
Cement rubble masonry	1-1/2 inches
Class A masonry	1 inch
Class B masonry	No rounding
Dimensioned masonry	No rounding

(e) Arch Ring Stone Joint Surfaces. Arch ring stone joint surfaces shall be radial and at right angles to the front faces of the stones. They shall be dressed for a distance of at least 3 inches from the front faces and soffits, from which points they may depart from a plane normal to the face not to exceed 3/4 inch in 12 inches. The back surface in contact with the concrete of the arch barrel shall be parallel to the front face and shall be dressed for a distance of 6 inches from the intrados. The top shall be cut perpendicular to the front face and shall be dressed for a distance of at least 3 inches from the front.

When concrete is to be placed after the masonry has been constructed, adjacent ring stones shall vary at least 6 inches in depth.

(f) Stratification. Stratification in arch ring stones shall be parallel to the radial joints and other stones shall be parallel to the beds.

(g) Finish for Exposed Faces. Face stones shall be pitched to the line along all beds and joints. The kind of finish for exposed faces shall be SHOWN ON THE DRAWINGS. The following symbols will be used, and they shall be understood to represent the type of surface or dressing specified below:

(1) Fine Pointed (F.P.). The point depressions shall be approximately 3/8 inch apart with surface variation not to exceed 1/8 inch from the pitch line.

(2) Medium Pointed (M.P.). The point depressions shall be approximately 5/8 inch apart with surface variations not to exceed 1/4 inch from the pitch line.

(3) Coarse Pointed (C.P.). The point depressions shall be approximately 1 to 1-1/4 inches apart with surface variations not to exceed 3/8 inch from the pitch line.

(4) Split or Seam Face (S.). The surface shall present a smooth appearance, be free from tool marks, and have no depressions below the pitch line and no projection exceeding 3/4 inch beyond the pitch line.

(5) Rock Faced (R.F.). The face shall be an irregular, projecting surface without indications of tool marks, with no concave surfaces below the pitch line, and with projections beyond the pitch line, when measured in inches, not exceeding the figure preceding the symbol as SHOWN ON THE DRAWINGS; for example, "1-1/2 R.F." means projections beyond the pitch line not exceeding 1-1/2 inches. Where a "variable rock face" is specified, stones of the same height of projection shall be distributed.

Removal of drill and quarry marks from the faces of stones in cement rubble masonry will not be required.

610.04
Quarry Operations

Quarry operations and delivery of stone to the point of use shall be organized to ensure that deliveries are well ahead of masonry operations. A sufficiently large stock of stone shall be kept on the site at all times to permit adequate selection of stone by the masons.

610.05
Mortar

Mortar shall meet the requirements of Subsection 705.05.

CONSTRUCTION

610.06 Excavation & Backfill

Excavation and backfill shall meet the requirements of Section 206A modified as follows:

For filled spandrel arches, the backfill shall be carefully placed to load the ring uniformly and symmetrically. The backfill material shall be approved by the Engineer and placed in horizontal layers, carefully tamped, and brought up simultaneously from both haunches. Wedge-shaped sections of backfill material shall not be placed against spandrels, wings, or abutments.

610.07 Falsework

Arch centering shall be constructed in accordance with construction drawings submitted by the contractor. Wedges shall be provided for raising or lowering the forms to the exact elevation and taking up any settlement occurring during loading. Centering shall be lowered gradually and symmetrically to avoid overstresses in the arch.

Centering shall rest upon jacks in order to take up and correct any slight settlement that may occur after the placing of masonry has begun. In general, centering shall be struck and the arch made self-supporting before the railing or coping is placed. For filled spandrel arches these portions of the spandrel walls shall be left for construction subsequent to the striking of centers as may be necessary to avoid jamming of the expansion joints.

610.08 Sample Section

When SHOWN ON THE DRAWINGS, the contractor shall build an L-shaped sample section of wall not less than 5 feet high and 8 feet long, showing examples of face wall, top wall, method of turning corners, and method of forming joints, that shall be subject to the Engineer's approval. No masonry, other than the foundation masonry, shall be laid prior to the approval of such samples.

610.09 Arch Ring Template

A full-size template of the arch ring shall be laid out near the quarry site, showing face dimensions of each ring stone and thickness of joints. The template shall be approved by the Engineer before the shaping of any ring stone is started, and no ring stone not corresponding to approved configuration shall be placed in the structure.

610.10 Selection & Placing

When the masonry is to be placed on a prepared foundation bed, the bed shall be firm and normal to, or in steps normal to, the face of the wall and shall be approved by the Engineer before any stone is placed. When it is to be placed on foundation masonry, the bearing surface of this masonry shall be cleaned thoroughly and wetted immediately before the mortar bed is spread.

Face stones shall be set in random bond to produce the effect SHOWN ON THE DRAWINGS and to correspond with the sample section approved by the Engineer.

Care shall be taken to prevent the bunching of small stones or stones of the same size. When weathered or colored stones or stones of varying texture are being used, the various kinds of stones shall be uniformly distributed throughout the exposed faces of the work. Large stones shall be used for the bottom courses and large selected stones shall be used in the corners. In general, the stones shall decrease in size from the bottom to the top of work.

All stones shall be cleaned thoroughly and wetted immediately before being set. The bed shall be cleaned and moistened before the mortar is spread. Stones shall be laid with their longest faces horizontal in full beds of mortar, and the joints shall be flushed with mortar.

The exposed faces of individual stones shall be parallel to the faces of the walls in which the stones are set.

Stones already set shall not be jarred or displaced. Equipment shall be provided for setting stones larger than those that can be handled by two men. Stones shall not be rolled or turned on the walls. If a stone is loosened after the mortar has taken initial set, it shall be removed, the mortar cleaned off, and the stone relaid with fresh mortar.

Arch ring stone shall be carefully set to exact positions and held in place with hardwood wedges until the joints are packed with mortar.

610.11
Beds & Joints

The thickness of beds and joints of face stones shall be as follows:

Type of Masonry	Beds (Inches)	Joints (Inches)
Cement rubble masonry	1/2 to 2-1/2	1/2 to 2-1/2
Class A masonry	1/2 to 2	1/2 to 2
Class B masonry	1/2 to 2	1/2 to 1-1/2
Dimensioned masonry	(See note)	3/4 to 1

Note: The thickness of beds in dimensioned masonry may vary from 3/4 to 1 inch from the bottom to the top of the work, but in each course the beds shall be of uniform thickness throughout.

Beds shall not extend in an unbroken line through more than 5 stones, and joints through more than 2 stones.

Joints in dimensioned masonry shall be vertical. In all other masonry, joints may be at angles with the vertical from zero to 45 degrees.

Each face stone shall bond with all contiguous face stones at least 6 inches longitudinally and 2 inches vertically.

The corners of four stones shall not be adjacent to each other.

Cross beds for vertical walls shall be level and for battered walls may vary from level to normal to the batter line of the face of the wall. All arch ring joints shall be completely filled with mortar.

610.12
Headers

Headers shall be distributed uniformly throughout the walls of structures to form at least one-fifth of the faces.

610.13
Backing

The backing shall be built chiefly of large stones and in a workmanlike manner. The individual stones composing the backing and hearting shall be well bonded with the stones in the face wall and with each other. All openings and interstices in the backing shall be completely filled with mortar or with spalls completely surrounded by mortar.

610.14
Coping

Copings shall be as SHOWN ON THE DRAWINGS. If copings are not SHOWN ON THE DRAWINGS, the top of the wall shall be finished with stones wide enough to cover the top of the wall, from 1-1/2 to 5 feet in length, and of random heights, with a minimum height of 6 inches. Stones shall be laid so the top course is an integral part of the wall. The tops of the top courses of stone shall be aligned in both vertical and horizontal planes.

610.15
Parapet Walls

Selected stones, squared and pitched to line and with heads dressed, shall be used in the ends of parapet walls and in all exposed angles and corners. Headers shall be well interlocked and as many as possible shall extend entirely through the wall. Both the headers and stretchers in the two faces of the wall shall be well interlocked in heart and shall comprise practically the whole volume of the wall. All interstices in the wall shall be completely filled with cement grout or with spalls completely surrounded with mortar or grout.

610.16
Facing for Concrete

The stone masonry shall be constructed before placing concrete. Concrete may be placed before constructing the stone masonry if approved by the Engineer.

(a) Stone Masonry Constructed Prior to Placing Concrete. Hooked steel anchors, consisting of No. 4 bars each bent into an elongated "S" shape, shall be spaced 2 feet apart both horizontally and vertically unless closer spacing is SHOWN ON THE DRAWINGS. To improve the bond between the stone masonry and the concrete backing, the back of the former shall be made as uneven as the stones will permit. Each anchor shall be rigidly embedded in a horizontal joint of the masonry with one end 2 inches from the faces of the stones. The other end shall project approximately 10 inches into the concrete backing.

When the stone facing has been laid and the mortar has attained sufficient strength, all surfaces against which concrete is to be placed shall be cleaned carefully and all dirt, loose material, and accumulations of mortar droppings removed. Picks, scrapers, and wire brooms shall be used for this purpose if necessary. If compressed air is available, it shall be used to blow out the dust and dirt. Just before the concrete is placed, the surfaces shall be washed thoroughly. Water shall be dashed forcibly against the stones and into the joints. Use of a stream from a hose is preferable for this purpose. In depositing concrete, the top surface immediately adjacent to the stones shall be held slightly low, and a neat cement grout of the consistency of cream shall be carried on top of the concrete and against the masonry at all times, so the entire exposed areas of all the stones are coated with grout. All interstices of the masonry shall be filled and the concrete thoroughly spaded and worked until it is brought into intimate contact with every part of the back of the masonry.

(b) Concrete Placed Before Constructing Masonry. Except where otherwise SHOWN ON THE DRAWINGS, a thickness of 9 inches shall be allowed for facing. Galvanized metal slots with anchors for the stone work, or other approved type of metal anchor, shall be set vertically in the concrete face at a horizontal spacing not to exceed 24 inches. The slots shall have a temporary filling of felt or other material to prevent them from being filled with concrete. During the setting of the stone facing, the metal anchors shall be fitted tightly in the slots at an average vertical spacing of 24 inches. The Engineer will mark on the concrete backing the approximate location of the anchors, and the anchor shall be placed in the stone joint nearest to the mark. At least 25 percent of the metal anchors shall have a short right-angle bend to engage a recess to be cut into the stone. The anchors shall extend to within 3 inches of the exposed face of the stone work.

Where the shape of the concrete face is unsuitable for the use of metal slots, ties consisting of U.S. Standard Gauge No. 9 galvanized iron wire shall be placed as approved by the Engineer, with not less than one wire tie for each 1.5 square feet of exposed stone surface. In laying the stone, the concrete face shall be kept wet continuously for 2 hours preceding the placing of the stone, and all spaces between the stone and concrete shall be thoroughly filled with mortar. Immediately after laying, all exposed stone surfaces shall be cleaned and kept clean of loose mortar and cement stains.

610.17
Pointing

The pointing or finishing of all joints shall be as SHOWN ON THE DRAWINGS.

When raked joints are called for, all mortar in exposed faced joints and beds shall be raked out squarely to the depth SHOWN ON THE DRAWINGS. Stone faces in the joints shall be cleaned free of mortar.

When weather joints are called for, the beds shall be weather struck. The joints shall be slightly raked to conform to the bed weather joint, and in no case shall the mortar be flush with the faces of the stones.

The mortar in joints on top surfaces shall be crowned slightly at the center of the masonry to provide drainage.

610.18
Weep Holes

All walls and abutments shall be provided with weep holes as SHOWN ON THE DRAWINGS.

610.19
Cleaning Exposed
Faces

Immediately after being laid and while the mortar is fresh, all face stone shall be thoroughly cleaned of mortar stains and shall be kept clean until the work is completed. Before the final acceptance, the surface of the masonry shall be cleaned using wire brushes and acid if necessary.

610.20
Weather
Limitations

Placing of stone shall not be done in freezing weather except by written approval from the Engineer, and then only by the use of precautionary methods prescribed for doing the work and protecting it at all times. This permission and the use of the prescribed methods will not release the contractor from an obligation to build a satisfactory structure. All work damaged by cold weather shall be removed and replaced. In hot or dry weather, the masonry shall be satisfactorily protected from the sun and shall be kept wet for a period of at least 3 days after completion.

MEASUREMENT

610.21
Method

The method of measurement, as described in Section 106, will be DESIGNATED in the SCHEDULE OF ITEMS.

Sample sections of wall, unless permitted to be incorporated in the work, will not be included.

The dimensions used in computing yardage will be those determined by the lines SHOWN ON THE DRAWINGS. No deductions will be made for weep holes, drain pipes, or other openings of less than 2 square feet in area, or for chamfers or other ornamental cuts that amount to 5 percent or less of the volume of the stone in which they occur.

PAYMENT

610.22
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
610(01) Cement Rubble Masonry	C.Y.
610(02) Class A Masonry	C.Y.
610(03) Class B Masonry	C.Y.
610(04) Dimensioned Masonry	C.Y.

Section 611 - Development of Pits & Quarries

DESCRIPTION

611.01
Work This work shall consist of clearing, grubbing, topsoil stripping, removal of overburden, access road development, restoration, and other incidental work required for pit or quarry development.

CONSTRUCTION

611.02
General All work shall be performed in accordance with Sections 201, 203, 625, landscape preservation requirements, and the pit and quarry development and/or restoration plan as SHOWN ON THE DRAWINGS.

611.03
Source Designation of sources will be in accordance with requirements SHOWN ON THE DRAWINGS or specified in the SPECIAL PROJECT SPECIFICATIONS.

611.04
Clearing, Grubbing
& Slash Cleanup Clearing, grubbing, and slash cleanup requirements shall be in accordance with Section 201 and as SHOWN ON THE DRAWINGS.

611.05
Access Roads Access roads to the pit or quarry shall be constructed or reconditioned in accordance with Section 203 or 306 and as SHOWN ON THE DRAWINGS.

611.06
Topsoil Stripping, stockpiling, and placing of topsoil obtained from the site shall be in accordance with Section 203 and as SHOWN ON THE DRAWINGS.

611.07
Overburden Removal of overburden to expose rock material for aggregate production and the stockpiling or placement of overburden in embankment within the limits of the pit or quarry shall be in accordance with Section 203 and as SHOWN ON THE DRAWINGS.

611.08
Ground Control
& Haulways The work shall be in accordance with MSHA 30 CFR-Part 56 that relate to ground control and haulways. Any deterioration of overburden slopes, safety benches, protective berms, or encroachment on clearing limits shall be immediately corrected.

611.09
Oversize Material All material suitable for aggregate, developed in stripping, overburden removal, and excavation of rock material, regardless of size, shall be utilized for aggregate unless other disposition is SHOWN ON THE DRAWINGS.

611.10
Restoration After excavation has been completed in a part or all of the area, the sides shall be sloped and graded and the general pit area smoothed as SHOWN ON THE DRAWINGS. Oversize material, if left in the pit or quarry, shall be evenly distributed and overburden material spread over the bottom of the pit prior to spreading topsoil.

Access roads SHOWN ON THE DRAWINGS for obliteration shall be ripped, drained, blocked to traffic, and seeded in accordance with Section 625.

MEASUREMENT

611.11
Method The method of measurement, as described in Section 106, will be DESIGNATED in the SCHEDULE OF ITEMS.

PAYMENT

611.12
Basis The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
611(01) Pit Development	EA.
611(02) Quarry Development	EA.

Section 613 - Reinforced Earth Walls

DESCRIPTION

613.01
Work This work shall consist of constructing Reinforced Earth (trademark), or equal, walls with standard-sized concrete or steel face panels.

MATERIALS

613.02
Concrete &
Steel Panels (a) Concrete Face Panels. Cement shall meet the requirements of Subsection 701.01. Air-entraining, retarding, or accelerating agents or any additive containing chloride shall not be used without approval of the Engineer.

Tie strips, connecting pins, and PVC pin form and lifting and handling devices shall be set in place as SHOWN ON THE DRAWINGS prior to casting.

(1) Testing and Inspection. Acceptability of the precast units will be determined on the basis of compression tests and visual inspection. The contractor shall furnish facilities and perform all necessary sampling and testing. Panels shall be considered acceptable for placement in the wall when 7-day strengths exceed 65 percent of 28-day requirements.

(2) Casting. The panels shall be cast on a flat area and have the front face of the form at the bottom and the back face at the top.

Tie strip guides shall be set on the rear face. The concrete in each unit shall be placed without interruption and shall be consolidated by the use of an approved vibrator, supplemented by hand tamping as necessary to force the concrete into the corners of the forms and prevent the formation of stone pocket or cleavage planes. Clear-form oil of the same manufacture shall be used throughout the casting operation.

(3) Curing. The units shall be cured for a sufficient length of time so that the concrete will develop the specified compressive strength.

(4) Removal of Forms. The forms shall remain in place until they can be removed without damage to the unit.

(5) Concrete Finish. Concrete surface for the front face shall have the finish SHOWN ON THE DRAWINGS. Rear face of the panel shall be roughly screeded to eliminate open pockets of aggregate and surface distortions in excess of 1/4 inch.

(6) Tolerances. All units shall be manufactured within the following tolerances:

- a. All dimensions within 3/16 inch.
- b. Angular distortions with regard to the height of the panel shall not exceed 0.20 inch in 5 feet.
- c. Surface defects on formed surfaces measured with a 5 foot straightedge shall not exceed 0.1 inch.

(7) Compressive Strength. Acceptance of the concrete face panels with respect to compressive strength will be determined on a lot basis. The lot will consist of all production units (batches of concrete or panels) produced within a week's or 7-day production. Production units shall be randomly selected in accordance with the production day sample sizes of table 613-1 and tested for compressive strength. Compression tests shall be made on standard 6-inch by 12-inch test specimens prepared in

accordance with AASHTO T 23 or cores obtained and prepared in accordance with AASHTO T 24. Compressive strength testing shall be conducted in accordance with AASHTO T 22.

Table 613-1.--Production day sample sizes.

Production Day Quantities	Sample Size
0-35 cu yds (0-50 panels)	1
36-70 cu yds (51-100 panels)	2
71-105 cu yds (101-150 panels)	3
Over 106 cu yds (+151 panels)	5

When standard 6-inch by 12-inch test specimens are utilized, a minimum of four cylinders shall be cast for each production unit sampled. Two of these specimens shall be cured in the same manner as the panels and tested at 7 days. The remaining two cylinders shall be cured in accordance with AASHTO T 23 and tested at 28 days. The test value of each two-cylinder group will be their average compressive strength.

Acceptance of the lot will be made if all acceptance tests in a lot are greater than 4,500 psi or no individual 28-day compressive strength test result falls below 4,000 psi and the average 28-day compressive strength of all test results for the lot equals or exceeds the acceptance limits set forth in table 613-2. The acceptance limits of table 613-2 shall also apply to core compressive strength test results.

Table 613.2.--Lot acceptance limits.

Number of Lot Acceptance Tests	Average of All Lot Acceptance Tests Must Equal or Exceed These Limits
3-7	4500 + 0.33R ^a
8-15	4500 + 0.44R ^a
16+	4500 + 0.46R ^a

^a(Range) - The difference between the largest and smallest acceptance test result.

(8) Rejection. Units shall be subject to rejection because of failure to meet any of the requirements specified above. In addition, any or all of the following defects shall be sufficient cause for rejection:

- a. Defects that indicate imperfect molding.
- b. Defects indicating honeycombed or open texture concrete.

(9) Marking. The date of manufacture shall be clearly scribed on the rear face of each panel.

(10) Handling, Storage, and Shipping. All units shall be handled, stored, and shipped in a manner to eliminate the danger of chipping, cracks, fractures, and excessive bending stresses. Panels in storage shall be supported on firm blocking located immediately adjacent to tie strips to avoid bending the tie strips.

(11) Concrete Footing. Concrete shall meet the requirements of Section 602, Method A or B as SHOWN ON THE DRAWINGS.

(b) Steel Face Panels. Steel face panels shall be fabricated of cold-rolled galvanized steel. Steel shall meet the requirements of ASTM A 446, Grade C, and galvanizing shall meet the requirements of ASTM A 525, Coating Class G 90.

(c) Reinforcing and Tie Strips. Tie strips shall be shop fabricated of hot-rolled steel meeting the requirements of ASTM A 570, Grade C, or equivalent. They shall be hot-dip galvanized in accordance with ASTM A 123. Reinforcing strips shall be hot rolled from bars to the required shape and dimensions.

Their physical and mechanical properties shall be in accordance with ASTM A 36 or equivalent.

They shall be cut to the lengths and tolerances SHOWN ON THE DRAWINGS. Holes for bolts shall be punched as SHOWN ON THE DRAWINGS.

All reinforcing and tie strips shall be carefully inspected to ensure they are true to size and free of defects that may impair their strength and durability.

(d) Fasteners, Bolts, and Nuts. Hardware shall be hexagonal cap screws AASHTO M 164, nominal size 1/2 inch by 1 inch, with a 3/4 thread length, hot-dip galvanized.

(e) Joint Filler for Use with Concrete Face Panels.

(1) Filler for vertical joints between panels shall be flexible open cell polyether foam strips, Grade 1035, 2 inches by 2 inches, meeting the requirements of ASTM D 1564.

(2) Filler for horizontal joints between panels shall be resin-bonded cork filler meeting the requirements of ASTM D 1752 (Type II) or an approved equal.

(f) Joint Covers for Use with Steel Face Panels. Joint covers shall be fabricated of cold-rolled galvanized steel. Steel shall meet the requirements of ASTM A 446, Grade C, and galvanizing shall meet the requirements of ASTM A 525, Coating Class G 90.

(g) Select Granular Backfill Material. All backfill material used in the structure volume shall be free of organic or otherwise deleterious materials and shall meet the following gradation limits as determined by AASHTO T 27:

<u>Sieve Size</u>	<u>Percent Passing</u>
6 inches	100
3 inches	100-75
No. 200	0-15

This material shall exhibit an angle of internal friction of not less than 25 degrees as determined by standard triaxial or direct shear testing methods.

Material meeting the above specifications shall be obtained from sources SHOWN ON THE DRAWINGS.

613.02a
Certification

The contractor or the supplier shall furnish a copy of all test results and Certificates of Compliance certifying that the materials comply with the applicable contract specifications. Approval will be based on the Certificate of Compliance, accompanying test reports, and inspection by the Engineer.

CONSTRUCTION

613.03
Wall Excavation

Excavation shall be in accordance with the requirements of Section 203 and the limits and construction stages SHOWN ON THE DRAWINGS.

613.04
Foundation
Preparation

The foundation for the structure shall be graded level for a width equal to or exceeding the length of reinforcing strips or as SHOWN ON THE DRAWINGS. Prior to wall construction, the foundation shall be compacted in accordance with Subsection 613.06 with a smooth-wheel vibratory roller meeting the requirements of Subsection 212.02(c) unless constructed on rock.

At each panel foundation level, an unreinforced concrete leveling footing shall be provided as SHOWN ON THE DRAWINGS when concrete face panels are specified. The footing shall be cured a minimum of 12 hours before placement of wall panels.

613.05
Wall Erection

(a) Concrete Face Panels. Panels shall be placed in successive horizontal lifts in the sequence SHOWN ON THE DRAWINGS as backfill placement proceeds. Panels shall be maintained in vertical position as backfill material is placed behind a panel.

Vertical tolerance (plumbness) and horizontal alignment tolerance shall not exceed 3/4 inch when measured along a 10-foot straight edge. The maximum allowable offset in any panel joint shall be 3/4 inch. The overall vertical tolerance of the wall (plumbness from top to bottom) shall not exceed 1/2 inch per 10 feet of wall height.

(b) Steel Face Panels. Skin elements shall be placed by hand in successive horizontal lifts as SHOWN ON THE DRAWINGS. Backfill must be maintained at a level of not more than two skin elements below the top of the wall. Panels shall be maintained in a vertical position as backfill material is placed behind a panel.

Vertical and horizontal alignment tolerances shall be the same as for (a) above.

613.06
Backfill Placement

Backfill placement shall closely follow the erection of each lift of panels. Backfill should be roughly leveled at each reinforcing strip level before placing and bolting strips. Reinforcing strips shall be placed normal to the face of the wall as SHOWN ON THE DRAWINGS. The maximum lift thickness shall not exceed 8 inches (loose). The lift thickness shall be decreased if necessary to obtain the specified density. The last level of backfill, at the end of each day's construction, shall be shaped to permit runoff of rainwater away from the wall face. Backfill shall be compacted in accordance with Subsection 203.15, Method 4, Method 5, or Method 6 as SHOWN ON THE DRAWINGS. Backfill compaction shall be accomplished without disturbance or distortion of reinforcing strips and panels. Compaction within 3 feet of the wall shall be achieved using light mechanical tampers.

613.07
(Reserved)

MEASUREMENT

613.08
Method

The method of measurement, as described in Section 106, will be DESIGNATED in the SCHEDULE OF ITEMS.

PAYMENT

613.09
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS. Excavation will be measured and paid for as provided in accordance with Section 203.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
613(01) Concrete Face Panels	S.F.
613(02) Steel Face Panels	S.F.
613(03) Select Granular Backfill	C.Y.

Section 614 - Damp-Proofing

DESCRIPTION

614.01 This work shall consist of damp-proofing concrete or masonry
Work surfaces with asphalt.

MATERIALS

614.02 Materials shall meet the requirements of the following Subsections:
Requirements

Primer 702.06 (a)
Asphalt 702.06 (b)

CONSTRUCTION

614.03 After the concrete has been finished and cured in accordance with
Performance the requirements of Section 602, the surfaces to be damp-proofed
shall be allowed to dry at least 10 days. They shall be coated
thoroughly with four coats of primer applied cold with a brush or
spray gun. Each coat shall be absorbed before the succeeding one is
applied. After absorption of the fourth coat, a seal coat shall be
applied at the specified temperature and brushed or sprayed
thoroughly into all surfaces. The seal coat shall have hardened
before any water or earth is placed against it. No coat shall be
applied to damp surfaces.

MEASUREMENT

614.04 The method of measurement as described in Section 106 will be
Method DESIGNATED in the SCHEDULE OF ITEMS. Area computations will be
based on surface area covered.

PAYMENT

614.05 The accepted quantities will be paid for at the contract unit price
Basis for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
614(01) Damp-Proofing	S.Y.
614(02) Damp-Proofing	L.S.
614(03) Damp-Proofing	GAL.

Section 615 - Waterproofing

DESCRIPTION

615.01 This work shall consist of the waterproofing of concrete surfaces.
Work

MATERIALS

615.02 Materials shall meet the requirements of the following
Requirements Subsections:

Primer for Use With Asphalt	702.06(a)
Asphalt for Mop Coat	702.06(b)
Waterproofing Fabric	702.06(c)
Mortar	702.06(d)
Asphalt Plank	702.06(e)
Asphalt Roll Roofing	702.06(f)
Membrane Material	702.07
Joint Fillers	705.01
Oakum	705.04
Welded Wire Fabric	709.01(e)

CONSTRUCTION

615.03 Membrane waterproofing shall be a firmly bonded membrane composed
Membrane of two layers of asphalt-treated fabric, three moppings of
Waterproofing asphalt, and a coating of primer, applied as follows:

Concrete surfaces to be waterproofed shall be smooth and free of projections or depressions that might cause puncture of the membrane.

The surface shall be dry and free of dust and loose materials. Waterproofing shall not be applied in wet or freezing weather.

Asphalt shall be applied at a temperature between 300 °F and 350 °F.

A coating of primer shall be applied and allowed to dry before any mop coat is applied.

The fabric shall be laid so that drainage will be over and not against or along the laps. It shall be shingled so there will be two thicknesses at all points. Edge laps shall be at least 4 inches and end laps at least 12 inches. One ply of fabric shall not touch another or the primed concrete surface.

Beginning at the lowest point of the surface to be waterproofed, a primed section about 20 inches wide shall be mopped with the hot asphalt. A strip of fabric of half the width of the roll shall be placed immediately on the hot asphalt and pressed carefully into place to expel all entrapped air and obtain close conformity with the surface. This strip and an adjoining area of concrete surface, slightly more than one-half the width of a roll, shall then be mopped with hot asphalt and a full-width strip of fabric shall be pressed into place as before, to cover completely the first strip. The second strip and an adjoining area of concrete surface shall then be mopped with hot asphalt and the third strip of fabric placed to lap the first by not less than one-half the width plus 4 inches. This process shall be continued until the entire surface is covered, each strip of fabric lapping at least one-half the width plus 4 inches over the past strip. The entire surface shall then be mopped with hot asphalt. The work shall be so regulated that at the close of the day's work the required mopping shall have been applied to all the fabric in place. All laps shall be thoroughly sealed down.

Under no circumstances shall one layer of fabric touch another layer at any point or touch the unmopped surface. In all cases the mopping on concrete shall cover the surface so no gray spots appear, and on cloth it shall be sufficiently heavy to completely conceal the weave. On horizontal surfaces, not less than 12 gallons of asphalt shall be used for each 100 square feet of finished work and on vertical surfaces not less than 15 gallons shall be used for each 100 square feet.

At the edges of the membrane and at any points where it surrounds such appurtenances as drains or pipes, provisions shall be made to prevent water from getting between the waterproofing and the concrete surface.

All flashing at curbs and against girders, spandrel walls, etc., shall have separate sheets lapping the main membrane not less than 12 inches. Flashing shall be closely sealed with a metal counter-flashing or by embedding the upper edges of the flashing in a groove poured full of joint filler.

Joints that are essentially open joints but not designed to provide for expansion shall be calked with oakum and lead wool and then filled with hot joint filler.

Horizontal and vertical expansion joints shall be provided with approved waterstops as SHOWN ON THE DRAWINGS and in accordance with Section 616. The membrane shall be continuous across all expansion joints.

At the ends of the structure, the membrane shall be carried well down on the abutments and suitable provision made for all movement.

615.03A
Bridge Deck
Waterproofing

Subsection 615.03 shall apply, except:

Bridge deck waterproofing shall be composed of an asphalt primer coat, two layers of asphalt-coated glass fabric, and three moppings of asphalt.

The asphalt primer coat shall be applied by brush or hand roller to penetrate the concrete and provide a bond between the concrete and the waterproofing. Primer shall be applied at the rate of 0.05 to 0.10 gallon per square yard, and only when the ambient air temperature is greater than 35 °F. Primer shall be allowed to cure a minimum of 4 hours prior to application of the waterproofing.

Surfaces shall be dry when the hot asphalt is applied. No waterproofing shall be done in wet weather or when the temperature is below 50 °F.

The bituminized glass fabric shall be shingled so there will be at least two thicknesses at all points. Edge laps shall be at least 2 inches. One ply of fabric shall not touch another or the primed concrete surface, since there must be three unbroken moppings.

The first strip of fabric shall be one-half of the width of the roll; the second shall be the full width of the roll lapped with the full width of the first strip; the third shall be the full width of the roll lapped one-half the width of the second strip plus 2 inches. Each succeeding strip shall lap one-half the width of the preceding strip so that there will be at least two layers of fabric at all points. No strips less than 12 inches wide shall be used.

On horizontal surfaces, not less than 3 gallons and not more than 4 gallons of asphalt mop coat shall be used for each mopping per 100 square feet of finished work; on vertical surfaces, not less than 4 gallons and not more than 5 gallons for each mopping per 100 square feet shall be used.

Each strip of fabric shall be carefully pressed into place to eliminate all air bubbles and provide a smooth, flat surface.

Waterproofing applied to surfaces that change abruptly in direction shall be reinforced at these points by application of an extra layer of fabric of suitable dimensions.

The waterproofing strips and course shall not be damaged during the placing of the pavement or by any other construction operation. Planks, plywood, or suitable sheet material shall be laid over the waterproofing when any trucking or tracking is unavoidable.

Special waterproofing at the juncture of the concrete deck slab and the curb shall be installed as SHOWN ON THE DRAWINGS and in conjunction with the placement of the bridge deck waterproofing. Approximately 1-1/2 inches of the waterproofing strip nearest the curbs shall be turned up into a specially provided recess directly beneath the face of the curb. The joint filler shall then be installed between the concrete deck and the underside of the curb and in front of the turned-up waterproofing.

Waterproofing at the juncture of the deck slab and scuppers, expansion joints, and manholes shall be accomplished by turning up the waterproofing at such junctures, with the waterproofing snug against the face to a point that will be flush with the wearing surface when placed.

615.04
Membrane
Waterproofing
with Mortar
Protection

Waterproofing membrane to be protected with mortar shall be constructed in accordance with Subsection 615.03.

Every part of the membrane, except undercut surfaces, shall be covered with a 2-inch course of reinforced mortar. Undercut surfaces are the undersides of parts of the structure that make an angle of less than 90 degrees with a horizontal plane. Reinforcement shall be 12-gauge welded wire fabric with 6-inch mesh or its equivalent, placed midway between the top and bottom surfaces of the mortar. The top surface of the mortar course shall be troweled to a smooth, hard finish. The protective mortar course shall be cured by burlap held in close surface contact and kept wet for 72 hours.

On undercut surfaces, the membrane shall be protected with a layer of asphalt roll roofing laid in hot asphalt instead of the mortar covering. The bituminous material shall be the same as used in mopping the membrane.

615.05
Membrane
Waterproofing with
Asphalt Plank
Protection

Waterproofing membrane to be protected with asphalt plank shall be constructed in accordance with Subsection 615.03.

The membrane shall then be covered with asphalt plank. The plank shall be laid in regular, straight courses as SHOWN ON THE DRAWINGS. Whole planks shall be used in all cases, except as otherwise required for closures and for fitting around openings and obstructions. Closing and trimming pieces shall be cut carefully to size. Before the planks are laid, all surplus talc or other powder shall be removed with a stiff brush or broom. Each piece shall be laid in a mopping of hot asphalt and the edges and ends of pieces in place shall be coated with the hot asphalt or tar before another piece is placed against them. Each individual piece shall be pressed tightly against the piece next to it and the completed work shall have a uniform, smooth surface with open joints.

MEASUREMENT

615.06
Method

The method of measurement, as described in Section 106, will be DESIGNATED in the SCHEDULE OF ITEMS. Area computation will be based on the surface actually covered.

PAYMENT

615.07
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
615(01) Membrane Waterproofing (Asphalt)	S.Y.
615(02) Membrane Waterproofing (Asphalt) with Mortar Protection	S.Y.
615(03) Membrane Waterproofing (Asphalt) with Asphalt Plank Protection.	S.Y.
615(04) Membrane Waterproofing	L.S.
615(05) Bridge Deck Waterproofing	S.Y.

Section 616 - Waterstops

DESCRIPTION

616.01
Work This work shall consist of constructing waterstops formed of rubber or plastic in expansion and construction joints.

MATERIALS

616.02
Requirements Materials shall meet the requirements of the following Subsections:

Rubber Waterstops	705.07
Plastic Waterstops	705.08

CONSTRUCTION

616.03
Performance The size, type, and locations of waterstops shall be as SHOWN ON THE DRAWINGS.

616.04
(Reserved)

616.05
Rubber Waterstops Splices shall be made watertight in accordance with the manufacturer's instructions. If splices are used, the contractor shall make at least one preliminary field splice sample for testing by the Engineer. No splicing shall be done until tests indicate a tensile strength of at least 50 percent of the tensile strength of the unspliced rubber waterstops.

616.06
Plastic Waterstops Splices shall be made water-tight without damage to the plastic, in accordance with the manufacturer's instructions. Preliminary splice samples shall be made and tested in accordance with Subsection 616.05 and no splices shall be made in the work until a tensile strength for splices of at least 80 percent of the unspliced plastic waterstops is indicated by tests.

616.07
Placing Waterstops Waterstops shall be placed at the locations SHOWN ON THE DRAWINGS. Waterstops shall not be displaced or damaged. All surfaces of the waterstops shall be kept free of oil, grease, dried mortar, or any other foreign matter while the waterstops are being embedded in concrete. All portions of the waterstops designed for embedment shall be tightly enclosed by concrete.

MEASUREMENT

616.08
Method The method of measurement, as described in Section 106, will be designated in the SCHEDULE OF ITEMS.

PAYMENT

616.09
Basis The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
616(01) Rubber Waterstop	S.F.
616(02) Rubber Waterstop _____ Width	L.F.
616(03) Rubber Waterstop	L.S.
616(04) Plastic Waterstop	S.F.
616(05) Plastic Waterstop _____ Width	L.F.
616(06) Plastic Waterstop	L.S.

Section 617 - Structural-Plate Pipe, Pipe Arches, & Arches

DESCRIPTION

617.01
Work This work shall consist of furnishing and installing, or installing only structural-plate pipe, or pipe arches, and arches.

This work shall also include joints and connections to pipes, catch basins, headwalls, and other appurtenances required to complete the structure.

MATERIALS

617.02
Requirements Materials shall meet the requirements of the following Subsections:

Grout	701.02
Structural Steel Plate for Pipe, Pipe Arch, and Arches. .	707.10
Full Bituminous-Coated Structural-Plate Pipe,	
Pipe Arch and Arches	707.11
Aluminum Alloy Structural Plate for Pipe, Pipe Arch, and Arches	707.12

CONSTRUCTION

617.03
Excavation, Bedding, & Backfill Excavation shall be in accordance with the requirements of Section 206A.

Pipe that is installed in or that will affect streams SHOWN ON THE DRAWINGS as important fisheries shall be installed only during those periods SHOWN ON THE DRAWINGS.

Bedding shall consist of bedding the pipe to a depth of not less than 10 percent of its total height. The foundation surface shall be excavated in accordance with Subsection 206A.03(b).

The bedding material shall be selected mineral soil meeting the same requirements as backfill material.

Pipe shall not be placed or backfilled until the excavation and foundation have been approved by the Engineer.

After the bedding is prepared and the pipe is placed, selected material shall be placed in layers not exceeding 6 inches loose thickness and compacted under the haunches and alongside the pipe. The material shall be readily compactible material free of frozen lumps, chunks of highly plastic clay, or other objectionable material. Rocks larger than 3 inches in greatest dimension shall not be used within 1 foot of the pipe. On each side of the pipe there shall be an area of compacted material at least as wide as one diameter of the pipe or 12 feet, whichever is less. Backfill shall be compacted without damaging or displacing the pipe.

Backfill density shall exceed 95 percent of the maximum density as determined by AASHTO T 99, Method C or D.

Backfilling and compacting shall be continued until the backfill is 12 inches above the top of the pipe.

After being bedded and backfilled, pipe shall be protected by an adequate cover of embankment as indicated in applicable cover height tables before heavy equipment is permitted to cross during roadway construction.

Pipe distorted more than 5 percent of nominal dimensions, ruptured, or broken shall be replaced.

When filling around and over arches before headwalls are in place, the first embankment material shall be placed midway between the ends of the arch, forming as narrow a ramp as possible, until the top of the arch is reached. The ramp shall be built evenly from both sides, and the embankment material shall be compacted as it is placed. After the two ramps have been built to the top of the arch, the remainder of the embankment material shall be deposited from the top of the arch both ways from the center to the ends, and as evenly as possible on both sides of the arch.

If the headwalls are built before any embankment material is placed around and over the arch, the embankment material shall first be placed adjacent to one headwall until the top of the arch is reached, after which it shall be dumped from the top of the arch toward the other headwall, depositing the material evenly on both sides of the arch.

The procedures specified above shall be followed in multiple installations and the embankment material shall be brought up evenly on each side of each arch so that unequal pressure will be avoided.

617.04
Fabrication

Plates for structural plate pipe, arches, and pipe arches shall be fabricated in accordance with AASHTO M 167 or M 219.

Plates shall be formed to provide lap joints. The bolt holes shall be punched so that all plates having like dimensions, curvature, and the same number of bolts per foot of seam shall be interchangeable. Each plate shall be curved to the proper radius so that the cross sectional dimensions of the finished structure will be as SHOWN ON THE DRAWINGS.

Plates for forming skewed or sloped ends shall be cut to give the angle of skew or slope SHOWN ON THE DRAWINGS. Legible identification numerals shall be placed on each plate to designate its proper position in the finished structure.

617.05
Footings for Arches

Footings for arches shall be constructed as SHOWN ON THE DRAWINGS.

617.06
Erection

Structural-plate pipe, arches, and pipe arches shall be erected in their final position by connecting the plates with bolts at longitudinal and circumferential seams. Drift pins may be used to facilitate matching of holes. All plates shall be placed in the order recommended by the manufacturer with joints staggered so that not more than three plates come together at any one point. All bolts shall be drawn tight, without overstressing, before beginning the backfill.

Steel bolts for structural-plate sections shall be torqued during installation to a minimum of 100 foot-pounds, and a maximum of 300 foot-pounds. The bolts for aluminum structural-plate sections shall be torqued during installation to a minimum of 100 foot-pounds, and a maximum of 200 foot-pounds.

Bolts shall be of sufficient length to completely engage the nut threads.

After steel pipe or arches have been erected, all damaged spelter shall be wire brushed and painted as specified in AASHTO M 167.

617.07
(Reserved)

MEASUREMENT

617.08
Method

The method of measurement, as described in Section 106, will be DESIGNATED in the SCHEDULE OF ITEMS.

PAYMENT

617.09
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
617(01) Steel Structural-Plate, Size _____, _____ Coated, _____ Thickness' . . .	L.F.
617(02) Aluminum Structural-Plate, Size _____, _____ Coated, _____ Thickness, . . .	L.F.
617(03) Installation Only.	EA.

When materials are furnished by the Forest Service, the note "Government-furnished materials" will be added to the description of the pay item.

Section 617A - Structural-Plate Long-Span Structures

DESCRIPTION

617A.01
Work

This work shall consist of furnishing and installing, or installing only, structural-plate long-span structures including such shapes as horizontal ellipse, low profile arch, and high profile arch. The work shall include the furnishing and placement of stiffening ribs or reinforced concrete thrust beams or other special structural features.

This work shall also include joints and connections to pipes, catch basins, headwalls, and other appurtenances required to complete the structure.

MATERIALS

617A.02
Requirements

Materials shall meet the requirements of the following Sections and Subsections:

Grout	701.02
Structural Steel Plate for Pipe, Pipe Arch, and Arches . . .	707.10
Full Bituminous-Coated Structural-Plate Pipe, Pipe Arch and Arches	707.11
Aluminum Alloy Structural Plate for Pipe, Pipe Arch and Arches	707.12
Reinforcing Steel	709

The thickness of the structural plate shall not be less than the plate thickness SHOWN ON THE DRAWINGS.

Concrete shall meet the requirements of Section 602, Method A or B as SHOWN ON THE DRAWINGS.

CONSTRUCTION

617A.03
Excavation,
Bedding, & Backfill

Excavation and backfilling shall be to the limits SHOWN ON THE DRAWINGS. Excavation shall be in accordance with the requirements of Section 206A.

Pipe that is installed in or that will affect streams SHOWN ON THE DRAWINGS as important fisheries shall be installed only during those periods SHOWN ON THE DRAWINGS.

Bedding shall consist of bedding the pipe to a depth of not less than 10 percent of its total height. The foundation surface shall be excavated in accordance with Subsection 206A.03(b).

The bedding material shall be selected mineral soil meeting the same requirements as backfill material.

Pipe shall not be placed or backfilled until the excavation and foundation have been approved by the Engineer.

After the bedding is prepared and the pipe is placed, selected material shall be placed in layers not exceeding 6 inches loose thickness and compacted under the haunches and alongside the pipe. The material shall be readily compactible material free of frozen lumps, chunks of highly plastic clay (Plasticity Index greater than 10), or other objectionable material. Rocks larger than 3 inches in greatest dimension shall not be used within 1 foot of the pipe. On each side of the pipe there shall be an area of compacted material at least as wide as one diameter or span of the structure or 12 feet, whichever is less. Backfill shall be compacted without damaging or displacing the pipe.

Backfill density shall exceed 95 percent of the maximum density as determined by AASHTO T 99, Method C or D.

Backfilling and compacting shall be continued until the backfill is 12 inches minimum above the top of the pipe.

After being bedded and backfilled, pipe shall be protected by an adequate cover of embankment before heavy equipment is permitted to cross during roadway construction.

Pipe distorted more than 5 percent of nominal dimensions, ruptured, or broken shall be replaced.

Prior to construction, a meeting shall be held at a time and place agreed to by the Engineer to discuss construction procedures. The meeting shall include the contractor, any involved subcontractor, and a qualified representative of the manufacturer of the arch structure.

Before backfilling, the erected structure shall meet the design shape within tolerances permitted by the manufacturer. If the structure is not within the allowable tolerances, suitable temporary supports shall be required to bring it into the proper shape.

The contractor shall monitor and record the horizontal and vertical displacement of the structure periodically during placement of backfill and embankment. These records shall be made available upon request to the Engineer. Displacements shall be measured to the nearest 1/8 inch at locations and frequencies established by the manufacturer's representative to ensure that the rate of change will not produce ultimate displacement beyond allowable tolerances. Structural backfill shall extend a minimum of 6 feet behind each thrust beam. Wheel or track machines shall be kept a safe distance away from the arch. If the rate of shape change for the structure exceeds the manufacturer's recommendation during backfill, backfill methods or materials, or both, shall be modified to keep structure shape within the manufacturer's tolerance.

A manufacturer's representative shall be on the site during all backfilling operations.

617A.04
Design &
Fabrication

Four sets of shop drawings of the plate structure shall be submitted to the Engineer a minimum of 21 days in advance of planned construction. Shop drawings shall be accompanied by all calculations used to determine the size, shape, location, and spacing of stiffening ribs, thrust beams, or other special structural features.

Plates shall be fabricated in accordance with AASHTO M 167 or M 219.

Plates shall be formed to provide lap joints. The bolt holes shall be punched so that all plates having like dimensions, curvature, and the same number of bolts per foot of seam shall be interchangeable. Each plate shall be curved to the proper radius so that the cross sectional dimensions of the finished structure will be as SHOWN ON THE DRAWINGS.

Plates for forming skewed or sloped ends shall be cut to give the angle of skew or slope SHOWN ON THE DRAWINGS. Legible identification numerals shall be placed on each plate to designate its proper position in the finished structure.

617A.05
Footings,
Headwalls,
& Collars

Footings, headwalls, collars and other associated concrete work shall be constructed as SHOWN ON THE DRAWINGS. Concrete work and placement of reinforcing steel shall be in accordance with Section 602.

617A.06
Erection

Long-span structural-plate structures shall be erected in their final position by connecting the plates with bolts at longitudinal and circumferential seams. Drift pins may be used to facilitate

matching of holes. All plates shall be placed in the order recommended by the manufacturer with joints staggered so that not more than three plates come together at any one point. All bolts shall be drawn tight, without overstressing, before beginning the backfill.

Steel bolts for structural-plate sections shall be torqued during installation to a minimum of 100 foot-pounds, and a maximum of 300 foot-pounds. The bolts for aluminum structural-plate sections shall be torqued during installation to a minimum of 100 foot-pounds, and a maximum of 200 foot-pounds.

Bolts shall be of sufficient length to completely engage the nut threads.

After steel structures have been erected, all damaged spelter shall be wire brushed and painted as specified in AASHTO M 167.

617A.07
(Reserved)

MEASUREMENT

617A.08
Method

The method of measurement, as described in Section 106, will be DESIGNATED in the SCHEDULE OF ITEMS.

The quantity of concrete or reinforcing steel used in thrust beams or additional structural metal or plates used in stiffening ribs or other special structural feature will not be included in the quantities for payment.

Concrete and reinforcing steel for footings, headwalls, and collars or other concrete work will be included under other items as indicated in the SCHEDULE OF ITEMS.

PAYMENT

617A.09
Basis

The accepted quantities will be paid for at the contract unit price for each pay item shown in the SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
617A(01) Steel Long Span Structures _____ Coated, _____ Span, _____ Rise, _____ Thickness, Shape _____ . .	L.F.
617A(02) Aluminum Long Span Structures _____ Coated, _____ Span, _____ Rise, _____ Thickness, Shape _____ . .	L.F.

When materials are furnished by the Forest Service, the note "Government-furnished materials" will be added to the description of the pay item.